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USSR Report

MILITARY AFFAIRS

No. 1538

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CONTENTS

NAVY DAY: ARTICLES BY SENIOR OFFICERS

Admiral Sorokin

Moscow AGITATOR in Russian No 13, Jul 80 signed to press 12 Jun 80 pp 25-27

[Article by Adm A. Sorokin, member of military council, chief of Navy Political Directorate: "The Motherland's Ocean Shield"]

[Excerpt] [Portion not translated provided a brief historical description of Soviet naval activities up to the end of World War II]

The Soviet people have been living and working under peaceful conditions for 35 years already. The Communist Party and the Soviet government have been struggling firmly and consistently for confirmation of the principles of peaceful coexistence of states with different social systems and for international collaboration, freedom, and the independence of peoples.

On the contrary, aggressive imperialist forces, especially recently, are doing everything to wreck the process of detente and aggravate the international situation; they are whipping up the arms race and organizing malicious anti-Soviet and anticommunist campaigns. The Beijing leaders are stepping forth in concert with these forces.

The aggressive NATO military-political bloc, which unites the biggest naval powers of the capitalist world, is speeding up an unprecedented growth in military expenditures and improving its fleets. The United States has concentrated the major part of its strategic nuclear weapons in its naval forces.

Under these conditions, our party is doing everything necessary to ensure the country's security and to maintain the combat readiness of the Armed Forces at a high level. The present stage of Soviet military organizational development is based on the radical, truly revolutionary changes which occurred in the Armed Forces. These changes pertain to equipment and armament, organizational structure and control, military science and military art, and the training, instruction, and indoctrination of personnel.

What is the Soviet Navy today?

In answering questions of the German Social-Democratic Party's Weekly VORWARTS, Comrade L. I. Brezhnev said as follows: "The Soviet Union has more than 40,000 kilometers of sea borders. Under conditions where the NATO countries have powerful offensive weapons at sea, we must think of the appropriate defense in this sphere, too. We have created our own ocean-going fleet which is able to accomplish the missions of such defense."

The beginning of the creation of a modern fleet was marked in the middle of the 1950's when the party and the government defined the basic lines for the development of the military-strategic situation on the World Ocean. Our Navy occupied a worthy place in the system of the Soviet Armed Forces. It is a qualitatively new fleet. It is armed with formidable and improved combat equipment and equipped with the most modern weapons and everything necessary to inflict crushing strikes on the aggressor.

The broad introduction of nuclear energy, nuclear missile weapons, and electronics changed the fleet's combat capabilities fundamentally. Its composition includes nuclear submarines equipped with missiles and torpedoes and surface ships which are represented by ships of various types. The combat capabilities of naval missile-carrying and antisubmarine warfare [ASW] aviation have grown immeasurably. The naval infantry, which was celebrated in the years of the Great Patriotic War, has been reconstructed on a new technical basis. Coast artillery units have been reequipped with weapons of great range and high accuracy.

The new fleet of the Soviet state dispelled the hopes of the imperialist strategists that they would not have a strong enemy in the sphere of armed conflict at sea.

The successful mastery of ocean conditions for sailing and combat training became one of the basic features in the activity of our fleet. It is namely on sea and ocean cruises that the professional and naval ability of the seamen and petty officers and the tactical skill of commanders are improved first of all and the combat readiness of the ships is consolidated. The tasks and interests of the entire ship's collective and the personal fates of the seamen are joined together on a long ocean voyage, especially underwater. Independent cruises are rallying the ship's crew to a degree heretofore unprecedented and are making the traditional naval friendship even stronger. It is not by chance that the words "seaworthy crew," that is, a crew which has undergone repeated tests by the ocean, is considered to be a high evaluation of the ship's collective in the fleet.

Let us take the large ASW ship "Petropavlovsk." Its log reads many tens of thousands of miles. The ship's seamen and petty officers, warrant officers [michman] and officers comprise a single serried military collective. A combat party organization is found on the ship and Komsomols, who make up the majority of the personnel, are operating actively and purposefully.

According to the results for the year 1979, the "Petropavlovsk" occupied first place in the force. Its crew stepped forth with the call to initiate socialist competition under the slogan, "Accomplish the Lenin behests in a sacred manner, improve combat and political training, increase vigilance, always be ready to defend the motherland and socialism's great achievements." The seamen greeted the 110th anniversary of V. I. Lenin's birth with new achievements in combat and political training. More than 4,000 seamen and petty officers, warrant officers, officers and admirals, and workers and employees of the fleet's enterprises and installations have been awarded Lenin Certificates of Honor. Active preparations have been initiated in the fleet for the 26th CPSU Congress. The communists and Komsomols are stepping forth as the pioneers of all patriotic undertakings.

The main and decisive force of the fleet is people. Expertly trained, energetic, and decisive admirals and officers, petty officers and seamen serve here. They are distinguished by a lofty sense of civic duty, moral maturity, masterful knowledge of their job, and physical endurance. Naval service develops will, endurance, self-control, and the ability not to be taken aback in any situation and to assume complete responsibility for the accomplishment of the assigned mission.

The combat training of the Soviet seamen proceeds in collaboration with the fleets of the Warsaw Pact's socialist member countries, the 25th anniversary of which was widely noted in the socialist countries. Joint exercises have become a genuine school of naval ability, for the indoctrinating of the fleets' personnel in a spirit of internationalism, and for the strengthening of combat friendship and collaboration.

Party-political work is directed toward the accomplishment of the missions facing the fleet's ships and units. Its goal is the mobilization of the personnel of ships and units for raising the level of combat and political training and indoctrinating the seamen in a spirit of loyalty to the Lenin behests and boundless devotion to their people and the Communist Party, high vigilance, class hatred for the enemies of communism, and constant readiness to repel any intrigues of aggressive forces.

Many young people are striving to perform their military service specifically in the fleet. Since olden times the sea has attracted the curious, seeking youth. At the same time, some youths, their parents, or their comrades at work or study are often apprehensive: will they be able to master the complex equipment and weapons of contemporary ships and withstand the moral-psychological and physical loads on long cruises?

I would like the agitators to stress in their talks with the youth that service in the fleet never was easy. And now it requires sufficient technical skill, self-control, organization, and constant internal mobilization. One should prepare himself for this.

The absolute majority of the draftees who come to the fleet "get on their feet" quickly and acquire the necessary knowledge and skills to service the

equipment of their battle stations. In fact, youths are arriving to serve in the fleet, more than 90 percent of whom have received a secondary or secondary technical education, and a considerable portion even have a specialty.

Conditions have been created in the fleet in which, i they try, the newcomers master the equipment successfully and receive permission to service it independently on time. During their years of service, the seamen acquire comprehensive knowledge and obtain specialties.

The seamen are linked with their people, their achievements, and concerns by indestructible ties. Patronage ties between Navy ships, units, enterprises, and installations on the one hand and local party, soviet, Komsomol, and trade union organizations, enterprises, kolkhozes, and educational institutions on the other have become a good tradition. Delegations from cities, oblasts, and union republics visit our fleets regularly. The seamen warmly receive the workers, kolkhoz workers, scientists, and representatives of the creative intelligentsia. In turn, envoys from the Navy are frequent guests of workers of the cities and villages. On the eve of Navy Day, the Komsomol Central Committee conducts a reception for the leaders in the socialist competition of the ships and units.

Well trained youths who are to carry the baton of loyalty to the glorious combat and revolutionary traditions over ocean roads are coming to the ships and units of the fleet under Komsomol travel orders.

Born under the banner of the Great October and surrounded by the nation's concern and love, our Navy, together with the other services of the Soviet Armed Forces and the armies and fleets of the socialist countries, are standing vigilant combat watch and guarding the peace.

Engineer-Admiral P. Kotov

Moscow TRUD in Russian 27 Jul 80 p 1

[Article by Engr-Adm P. Kotov, deputy commander in chief of the Navy: "Ocean Watch"]

[Excerpts] In accordance with the decision of the CPSU Central Committee, an ocean-going nuclear missile fleet is being created in our country since the middle of the 1950's. The fleet's basis is now nuclear submarines equipped with ballistic missiles and possessing virtually unlimited cruising range. The fleet has surface ships which are capable of participating in a nuclear missile war. Naval aviation has become jet, all-weather, and supersonic.

Soviet nuclear submarines demonstrated their excellent sea-going qualities under the age-old ice of the North Pole and in tropical latitudes during a round-the-world voyage. For outstanding exploits and the skillful use of

combat equipment, many seamen were awarded orders and medals in time of peace. More than 20 of them were awarded the title of Hero of the Soviet Union.

Our fleet also has missile, antisubmarine warfare, landing, mine countermeasures, landing and other ships equipped with contemporary weapons to combat enemy surface ships, submarines, and airplanes. It emerged from coastal and closed seas to the expanses of the World Ocean.

Nuclear power and nuclear weapons in combination with missiles for various purposes and electronic equipment have given the fleet new qualities and transformed it into a force capable of exerting decisive influence on the course of big operations.

The naval infantry which was renowned during the war years has been reconstructed on a new technical basis. Now it is capable of launching surprise strikes on the most important directions of the enemy's maritime forces and of rendering reliable support for our ground forces.

Our ocean-going nuclear missile fleet was created to defend the country's security. It did not have and cannot have any aggressive aspirations as some reactionary circles connected with NATO try to represent. The Soviet Navy is accomplishing its primary mission--it is standing vigilant guard over the security of the countries in the socialist commonwealth and guard over the peace of the entire world.

The qualitative changes in the fleet have also imposed increased requirements on the personnel. In connection with the arming of the fleet with new, first-class equipment, the volume of knowledge and the range of theoretical questions which the contemporary seaman must master has grown extremely.

The number of experts of combat and political training, rated specialists, and masters of military affairs is growing in the course of socialist competition. In the fleet now, every other seaman is an expert of combat and political training and the majority of the seamen are rated specialists. The officer personnel of the nuclear submarines and other combat ships have a higher education, and more than 90 percent of the fleet's officers are communists and Komsomols.

The contemporary Soviet ocean-going nuclear missile fleet is the creation of the entire people. But a special role in its creation belongs to the enterprises, scientific-research and design institutions, all scientists, engineers, and technicians, and workers and employees of the shipbuilding and defense industries of our country. Today, the shipbuilding industry has a high production and scientific-technical potential for the creation of improved ships.

The contemporary international situation requires of us constant vigilance, high combat readiness, and continuous improvement of our combat skill. The seamen are improving their combat abilities from day to day in strained

combat training, on long ocean cruises, and on exercises. They always keep their "powder dry" in order to inflict a crushing strike on the aggressor at any time on the call of the party if he dares to disrupt the peaceful labor of the Soviet people--the creators of communism.

The personnel of the fleet's units and ships are greeting Soviet Navy Day with successes in combat and political training. The defenders of the sea borders are showing themselves to be models of selfless military labor on tactical exercises and on long ocean cruises, and the seamen are tirelessly increasing vigilance and combat readiness.

In the photo [not reproduced]: the large ASW ship "Marshal Timoshenko." The crew members are going on shore leave.

Vice Admiral Usenko

Moscow AGITATOR ARMII I FLOTA in Russian No 13, Jul 80 signed to press 27 Jun 80 pp 2-6

[Article by Vice Adm N. Usenko, Hero of the Soviet Union, member of military council and chief of Political Directorate of Red Banner Northern Fleet: "The Fleet on Ocean Watch"]

[Excerpts] [Portion not translated covered Soviet Naval History up to the end of World War II]

On 27 July the Soviet people mark Soviet Navy Day. On this holiday, which was established by the Soviet government in 1939, the Country of Soviets honors the naval personnel, personnel of the shipbuilding and defense industries, and veterans of the fleet--all those who are strengthening the ocean might of the Soviet state.

All Navy personnel are closely rallied around the Communist Party and wholeheartedly support its foreign and domestic policy. They are demonstrating constant readiness to stand up for the defense of the Great October's achievements at any moment and under any conditions on long sea and ocean cruises and flights.

This year--the year of the 110th anniversary of V. I. Lenin's birth and the 35th anniversary of the Soviet people in the Great Patriotic War--has been marked by the persistent struggle of the Soviet Armed Forces personnel, to include naval personnel, to implement the requirements of the Communist Party, the Soviet Ministry of Defense, and the Main Political Directorate of the Soviet Army and Navy for improving the quality of combat and political training, a further strengthening of discipline, and increasing vigilance and combat readiness.

The men of the fleet are working in an intensified manner in the summer training period. The personnel of the units and ships received the decision of the June (1980) plenum of the CPSU Central Committee which adopted the

decree on convening the next, 26th, Party Congress with great enthusiasm. Unanimously approving the provisions of the report by Comrade L. I. Brezhnev and the domestic and foreign policy of the CPSU, the naval personnel are filled with resolve to achieve new successes in military labor. Socialist competition for a worthy greeting for the 26th CPSU Congress has been initiated everywhere on the initiative of the leading collectives in the fleet.

The Soviet Navy changed unrecognizably in the postwar period. It was rebuilt from the bottom up. Nuclear missile carriers which embody the latest achievements of Soviet industry, science, and technology are the pride of the fleet. They are armed with underwater-launched ballistic missiles and homing torpedoes and are capable of accomplishing long voyages under water in short times.

Supersonic missile-carrying aviation capable of accomplishing difficult missions on the expanses of the World Ocean in concert with submarines has become an important component part of the fleet.

Surface ships have also changed. They are equipped with contemporary missiles and powerful antiaircraft missile and artillery armament.

The naval infantry, which has armed itself with everything better from the combat experience and traditions of the naval infantrymen from the times of the Great Patriotic War, has been reconstructed on a new technical basis.

Having various missile and artillery weapons, the coast defense units are dependably covering the maritime positions and ensuring the protection of coastal lines of communications.

The quantitative and qualitative change in the Soviet Navy led to where it became a missile, ocean-going navy itself.

The naval personnel constantly sense the attention and concern of the Communist Party and the Soviet government. The leaders of the party and the government often visit the ships and units of the fleet, meet with the personnel, and manifest fatherly concern for the naval personnel.

The high evaluation of their military labor which was given at the 25th Party Congress in the speeches of Comrade L. I. Brezhnev and other leaders of the party and the government inspires the seamen to new successes in combat and political training.

The crew of the large antisubmarine warfare [ASW] ship "Petropavlovsk" of the Red Banner Pacific Fleet which was the initiator of socialist competition occupies a worthy place among the leaders of combat training.

Together with all the youth of the country, in the year of the 110th anniversary of V. I. Lenin's birth and the 35th anniversary of the Soviet people's victory in the Great Patriotic War, the Komsomols and the young servicemen of the fleet have joined in the "relay race" of Komsomol glory which is dedicated to the significant jubilees.

Ships which bear the name of the Lenin Komsomol and local Komsomol organizations are the pride of the fleet. The best of them are the nuclear submarines "[illegible]" and "Leninskiy Komsomol" and the large landing ships "[illegible] Komsomol" and "Tambovskiy Komsomol." The names of the competition leaders are well known in the fleets. Among them: the commander of a subunit which accomplished more than 100 landings on the deck of the cruiser "Kiev," pilot Captain N. Rudenko, a signalman of a nuclear submarine who took part in a long cruise to the North Pole beneath the ice, Navy expert Petty Officer 1st Class N. Shtanenko, deep diver and master of military affairs Senior Lieutenant A. Milonov, and participant in four ocean voyages and Komsomol group organizer of a subunit who displayed bravery, heroism, and resourcefulness in a difficult situation, Senior Seaman A. Ivanov.

The nature of naval service and the missions to be accomplished by the seamen require that they have good health and a high level of physical conditioning. Physical culture and sports help them to instill within themselves such qualities as endurance, discipline, steadfastness, and bravery. A movement has been initiated widely on the ships and in the units under the slogan, "From the VSK [military sports complex] badge--to Olympic medals." Many fleet sportsmen attained the right among the strongest sportsmen of the Armed Forces to participate in Olympiad-80. This honor was awarded to water-polo players--Olympic champion Lieutenant A. Kabanov, masters of sports of the international class Senior Lieutenants V. Sobchenko and V. Akimov, and Seaman V. Shotkov. Olympic champions Senior Lieutenant Yu. Lobanov, Seamen S. Chukhray and S. Petrenko, and world championship prize winner Warrant Officer [michman] S. Limanovich are preparing to defend the honor of the country's combined team for rowing in kayaks and canoes.

The service of the naval personnel is difficult and honorable. On and beneath the water, in the air, and on land--they are ready to defend the honor and security of the Soviet fatherland everywhere, at any minute. Ocean voyages contribute to the molding of lofty moral and fighting and political qualities in the personnel.

At a conference of leading command and political personnel of the armed forces which discussed the question of further strengthening of the indoctrinational role of the Soviet Armed Forces, the special significance of such types of military labor as exercises, missile launches, flights, combat duty, and voyages of submarines and surface ships in the World Ocean for the lofty moral-political and psychological tempering of the men was stressed.

Purposeful and broad work is being conducted on the communist indoctrination of the naval personnel on all ships on long cruises. The sailing days are saturated with full-blooded ideological life in which an important role is allotted to oral political agitation. Far from the motherland, news of the native country, the successes of the Soviet people and the countries of the socialist commonwealth, and the international situation are perceived in a special manner. The fleet agitators also consider this in their work. Being in the compartments and at the battle stations, they strive to bring the party's word to each man.

In their daily activity, the agitators of the ships and units of the Navy are conducting important work on the accomplishment of the tasks put forth in the decree of the CPSU Central Committee, "On further improvement of ideological and political-indoctrinational work,"--to augment the glorious traditions of the armed forces, service in which is a remarkable school of labor and military training, moral purity and bravery, patriotism, and comradeship.

In the year of the 35th anniversary of the Soviet people's victory over fascist Germany, the agitators intensified their work on indoctrinating the seamen in the heroic traditions of the older generations. Using the vivid facts of history and present-day reality, they explain convincingly the essence of our traditions, their sources and content, their continuity and vitality, and the majesty of the Soviet people's exploit. For example, one of the subjects of the talks by agitators on the ASW cruiser "Minsk" was called: The book by Comrade L. I. Brezhnev, 'Malaya Zemlya,' on the sources of the heroism and bravery of the Soviet fighting men, their communist conviction, and loyalty to the socialist motherland."

The combat training of the Soviet seamen is often conducted jointly with the fleets of the Warsaw Pact member countries whose 25th anniversary was ceremoniously marked recently. This permits working out coordination in the course of assigned missions, contributes to a unity of views on the most important questions of military art and to improvement in the training of commanders and staffs, and also strengthens the fraternal friendship of the servicemen of countries in the socialist commonwealth.

Our fleet threatens no one. It is always ready to defend reliably the state interests of the Country of Soviets and the entire socialist commonwealth and to cool the ardor of those who love military adventures and of the enemies of the peace and security of peoples.

Vice Admiral Kapitanets

Riga SOVETSKAYA LATVIYA in Russian 27 Jul 80 p 1

[Article by Vice Adm I. Kapitanets, deputy commander of Twice Red Banner Baltic Fleet: "Guarding the Motherland"]

[Excerpts] The combat traditions which were born in the battles with our motherland's enemies inspire today's guardians of the sea boundaries for the profound mastery of equipment and weapons and a further raising of vigilance and combat readiness. Thanks to the concern of the party and the Soviet government, our Navy has been transformed into a mighty force. It has become nuclear, missile, and ocean-going. The basis of the fleet's combat might consists of nuclear submarines equipped with improved means for navigation, control, and communication and armed with various missiles and homing torpedoes.

Our surface ships of various classes and for various purposes--antisubmarine warfare (ASW), missile, mine countermeasures, landing, and others can operate successfully on the broad ocean expanses. We are proud of our naval, missile-carrying, and ASW aviation; in close coordination with ships it can accomplish difficult missions in contemporary sea operations. Our naval infantry is a worthy heir to the glory of the heroes of the Great Patriotic War.

The chief wealth of our fleet consists of remarkable people who are boundlessly devoted to the party and the nation. About [illegible] percent of the officer personnel are Communists and Komsomols.

The months of this year's combat training which have passed have been marked in our fleet by new heat in the struggle for the quality accomplishment of the tasks in combat and political training and the socialist obligations which have been assumed. Closely rallied around the Communist Party and its Leninist Central Committee, the Baltic Fleet personnel have planned new goals in combat training and have joined actively in the socialist competition for a worthy greeting for the 25th CPSU Congress.

Wherever the Baltic Fleet personnel may be, they always feel the indissoluble unity with their people and with their native party. They are constantly strengthening bonds with party, Komsomol, and soviet organs and with the collectives of plants, factories, kolkhozes, and sovkhozes. A long-standing firm friendship was established among the seamen of the Twice Red Banner Baltic Fleet with the workers of the Latvian SSR which recently widely marked the [illegible] anniversary of the restoration of Soviet authority.

Party, soviet, and Komsomol personnel of Soviet Latvia are participating actively in ideological-indoctrinational work, frequently visit ships and units, and tell the seamen about the labor successes of the Soviet people. The workers of the republic are becoming patrons of the sea-going minesweeper "Komsomolets Latvii" whose crew is successfully accomplishing its socialist obligations.

In turn, the Baltic Fleet personnel are participating actively in the patriotic indoctrination of young boys and girls, in the training of the youth for service in the army, and are helping local party, soviet, and Komsomol organizations in many ways.

In recent years alone, ships of the Baltic Fleet made official visits of friendship and business calls in ports of Poland, the GDR, Cuba, Yugoslavia, Great Britain, France, Sweden, Finland, and many other countries. Wherever the Soviet man-of-war ensign may flutter, it always serves as a symbol of our might, friendship, peace, and solidarity. Ties between Soviet seamen and our brothers-in-arms--the personnel of the fleets of the Warsaw Pact's participating countries--are continuing to expand.

The Baltic Fleet personnel, together with all Soviet people, are working with tremendous inspiration on implementing the historic decisions of the 25th CPSU Congress, the decrees of plenums of the CPSU Central Committee, and the

[illegible], [illegible] and in communist [illegible] contained in the speeches of the General Secretary of the CPSU Central Committee and Chairman of the Presidium of the USSR Supreme Soviet, Comrade L. I. Brezhnev. They ardently approve the wise policy of the Leninist party which is confidently leading the people along the path to communism and they are manifesting tireless concern for the strengthening of the fatherland's economic and defensive might.

Forces of world reaction are stubbornly opposing a relaxation of tension. The United States obviously does not desire to manifest a constructive approach to the solution of the problems of disarmament. The Beijing leaders are stepping forth in unison with this position. All this requires a high level of combat readiness and political vigilance of the Soviet servicemen.

Servicemen of the Twice Red Banner Baltic Fleet, in one formation with all of the mighty Soviet Armed Forces, are always ready for the defense of the Soviet people's peaceful, creative labor and the state interests of our beloved motherland.

Vice Admiral A. M. Kalinin

[illegible] MORSKOY SBORNIK in Russian No 7, Jul 80 p [illegible]

[Article by Vice Adm A. M. Kalinin, chief of staff of Twice Red Banner Baltic Fleet: "Guarding the Fatherland's Sea Borders"]

[illegible] A new chapter in the history of the Soviet state and its Armed Forces was begun in the postwar period. The war wounds were healed in short order and the motherland's economic and defensive might was raised to an unprecedented height. It is especially pleasant for the Baltic Fleet servicemen to realize that a significant contribution to the common labor successes of the Soviet people is being made by the workers of the Baltic republics and the Kaliningradskaya oblast on whose territory the fleet is based.

The successes of the Soviet people in communist construction and the indefatigable activity of the CPSU Central Committee's Politburo in implementing the program of peace worked out by the 24th and 25th Party Congresses won tremendous international prestige for our motherland. The USSR is doing everything to stave off the threat of a new world war.

In making a realistic estimate of the situation, one cannot also fail to see facts of a different order. The forces of aggression are pressed, but not rendered harmless. American imperialism and the NATO countries are continuing preparations for war and persistently improving the giant war machine which they have created. The anti-Soviet activity of today's Beijing leaders is exerting a negative influence on the entire international situation.

Considering the complexity of the international situation, as formerly the party and the Soviet state proceed from the indivisibility of the tasks for

strengthening peace and the country's defense. Thanks to the attention and concern of the party and its Leninist Central Committee and to the heroic efforts of the Soviet people, the mighty Armed Forces have been created and their composition includes the ocean-going nuclear missile Navy which is capable of operating in any regions of the World Ocean, successfully opposing the enemy's naval forces, and accomplishing other missions. Our fleet has now become an important means for restraining the aggressor and a reliable shield which is protecting the world socialist system.

The combat readiness of the Twice Red Banner Baltic Fleet has also increased. Consisting of missile-carrying aviation, submarines and surface ships of various classes, coast missile and artillery units, and naval infantry, it possesses great combat capabilities, guaranteeing the inviolability of the boundaries of our Motherland and the entire socialist camp.

The Baltic Fleet is multinational; representatives of all the nations and nationalities of our boundless motherland are performing their service here. The firmly established friendship of the peoples of the USSR, a single multinational family, is reflected from year to year in the achievements of the fleet's collective as in a mirror. Representatives of the Estonian Soviet Socialist Republic are performing their military duty together with Russians, Ukrainians, and Belorussians. Comrades T. Tiako, A. Kayvlapea, T. Vaimyae, [illegible], and others presented themselves in a good light by their outstanding performance of their service duties.

The tasks of the summer training period are being accomplished successfully. High results were attained by the crew of the sea-going minesweeper "[illegible]," the escort ships "Druzhnyy" and "Bditel'nyy," and a number of submarines. The fleet's aviators, who are accomplishing flights under difficult conditions, are demonstrating bravery and a high level of flying skill. A number of them have been cited by the commander in chief of the Navy.

The efforts of the Baltic Fleet personnel are directed toward the struggle for the complete accomplishment of the plans for combat and political training. They deeply realize that to greet the 26th Party Congress in a worthy manner means the persistent mastery of contemporary weapons, raising combat skill to a new stage, and being a reliable guardian of the Soviet people's peaceful labor.

Rear Admiral D'yakonskiy

Alma-Ata KAZAKHSTANSKAYA PRAVDA in Russian 27 Jul 80 p 3

[Article by Rear Adm [illegible] D'yakonskiy, first deputy chief of Navy Political Directorate: "Ocean-Going Fleet of the Country of Soviets"]

[Excerpts] In July of each year, the Soviet people and the men of the Armed Forces ceremoniously mark Navy Day which was established by the Soviet government in 1939. On the request of a TASS correspondent, the first deputy chief of

the Navy Political Directorate, Rear Admiral N. P. D'yakonskiy, tells about the conception of the Navy, its combat history, and the glorious deeds of today's generation of Soviet seamen.

In accordance with Leninist foreign policy principles the Soviet Union, together with the fraternal socialist countries, is persistently and consistently struggling to relax international tension and for a firm peace on earth.

However, the military-political situation in the world has become noticeably more complex recently. Under pressure of the West's militaristic circles, the NATO countries are continuously increasing military budgets, intensifying the arms race, and feverishly building up their military might. The United States is setting the tone for these military preparations. It has doubled military expenditures during the last 10 years. Implementation of NATO plans for the stationing of qualitatively new American medium-range missiles in Europe represents a great danger for the cause of peace and detente.

The decree of the June (1980) plenum of the CPSU Central Committee, "On the International Situation and the Soviet Union's Foreign Policy," notes that the intrigues of imperialism and other enemies of peace require constant vigilance and the utmost strengthening of our state's defensive capability in order to defeat imperialism's plans for the attainment of military superiority and the implementation of world dictation.

The steadfast course of our party in the field of domestic and foreign policy and our successes in communist construction inspire the Soviet servicemen to the irreproachable performance of their patriotic and international duty, to new, remarkable deeds to the glory of the motherland, and to the vigilant performance of service and the persistent accomplishment of plans for combat and political training. The Soviet people can be confident: the Soviet Armed Forces and their integral component part, the Navy, are capable of defending the fruits of the great creation reliably and of giving a crushing rebuff to any aggressor.

Rear Admiral Petrov

Moscow SOVETSKIY PATRIOT in Russian 27 Jul 80 p 1

[Article by Rear Adm I. Petrov, deputy chief of Navy Political Directorate: "Sentinels of the Ocean Boundaries"]

[Excerpts] The Soviet Union's victory over the shock forces of imperialism was an event of worldwide historic significance. It had the most profound influence on the entire course of world development. The correlation of forces in the world arena changed in favor of socialism. However the seamen, just as all Soviet servicemen, realize that the danger of a new war remains as long as imperialism exists. The arms race is not weakening in the NATO

countries and the frantic propaganda of anticommunism and anti-Sovietism as well as inflation of military budgets are not stopping. The militarization of China represents a serious danger for the cause of peace.

The naval personnel are unaminously supporting the peace-loving foreign-policy course of our party and the government, believe firmly in the victory of this course, and are opposing the intrigues of the enemies of detente with lofty vigilance and a firm resolve to defend the interests of the motherland and the achievements of socialism.

During the years which have passed since the Great Patriotic War, our fleet has been transformed into a truly modern one as a result of the scientific and technical revolution. It has become nuclear, missile, ocean-going, and capable of accomplishing strategic missions. The basis of the fleet's combat might consists of nuclear submarines armed with various missiles and homing torpedoes. Surface ships of various classes and purposes--antisubmarine warfare [ASW], missile, landing, and others--also have contemporary weapons and can operate successfully on the broad ocean expanses. Proper pride is caused by naval missile-carrying and ASW aviation which, in close coordination with the ships, is capable of accomplishing difficult missions in operations. The naval infantry, reconstructed on a new technical base, steps forth as a worthy heir to the glory of heroes.

But nevertheless, the main wealth of the fleet consists of people who are boundlessly devoted to the Communist Party and their nation. It is important to stress that the fleet now is young as never before in the broadest meaning of this word. Its people, ships, and their commanders are young. And youths are arriving who possess a high technical and general style, many of whom have gone through training in DOSAAF organizations. Almost 100 percent of the seamen and petty officers have a higher, secondary, and incomplete secondary education.

The personality type of the Soviet seaman was molded under the influence of such factors as the socialist way of life, the scientific and technical revolution, the growth in professional and general style and, finally, the specific nature of naval service. Such features as communist conviction, moral-political and psychological steadfastness, professional skill, discipline and a high sense of responsibility for the assigned matter are inherent in him.

Ocean voyages and long cruises have become a school of combat ability. Here the skill of the crews is improved, difficult training missions are worked out, and the political maturity of people and their loyalty to the oath and military duty are checked.

Moved by patriotic feelings, the seamen are participating in socialist competition under the slogan, "Accomplish the Lenin behests in a sacred manner, improve combat and political training, increase vigilance, and always be ready to defend the motherland and socialism's great achievements," and they

are struggling for excellent ships and units, leading forces and fleet, and for the right to be called best in a specialty--followers of the heroes of the war years.

This year the best forces, ships, and units have been awarded the Leninist Certificate of Honor.

With the summer period in full swing, the fleet's personnel are not reducing efforts in combat training and are persistently continuing to work on the accomplishment of stepped-up obligations. Going in advance are the initiators of the socialist competition for the current year--the seamen of the large ASW ship "Petropavlovsk" of the Red Banner Pacific Fleet. High indices in combat and political training were attained by the crews of the nuclear submarine "60 let Velikogo Oktyabrya" of the Red Banner Northern Fleet, the large landing ship "Donteskiy shakhter," the training ship "Smol'nyy," the escort ship "Sovetskiy Azerbaijan," and others.

The communists and Komsomols step forth as the cementing force of the fleet collectives. They are the pioneers of many patriotic undertakings and interesting deeds. The initiatives "An outstanding result for each day of the cruise," "Komsomol concern for the training base," and others which received dissemination everywhere made the struggle for high quality of combat training and effectiveness in the accomplishment of each task more effective.

The Navy is accomplishing its missions with honor within the framework of the Warsaw Pact Organization. The ties of the allied fleets are being strengthened, an exchange of experience in combat and political training is taking place, and joint measures are being conducted which permit working out the cooperation of the personnel, generating a unity of views on questions of military art, improving the training of commanders and staffs, and raising the naval, aerial, and field ability of the troops.

The ties of the naval personnel with the workers of the defense industry, the shipbuilders of the sea and river fleets, and with the DOSAAF organizations are being strengthened. The military and civilian sailors often follow the same ocean courses and help each other.

In responding to the concern of the party and the people, the Navy is always ready to defend the achievements of socialism dependably together with the other services of the Armed Forces and in a single formation with the armies and navies of the Warsaw Pact countries.

Rear Admiral I. Alikov

Vilnyus SOVETSKAYA LITVA in Russian 26 Jul 80 p 2

[Article by Rear Adm I. Alikov, member of military council, chief of Political Directorate, Twice Red Banner Baltic Fleet: "Guarding the Fatherland's Sea Borders"]

[Excerpts] Thanks to the constant concern of the CPSU our country's fleet, just as the other services of the Armed Forces, is equipped with contemporary combat equipment and has become ocean-going and nuclear missile. Its basis consists of nuclear submarines. Powerful power plants, nuclear missile weapons, and electronic equipment have given the fleet new qualities and moved it forward into the category of strategic forces.

Important steps in improving party-political work on the ships and in the units were the books by L. I. Brezhnev, the decisions of the plenum of the party's Central Committee, the decree of the CPSU Central Committee, "On further improvement of ideological and political-indoctrinational work," and materials of the conference of leading command and political personnel of the Armed Forces which was conducted this June in Moscow.

Being guided by the party's instructions, purposeful ideological and indoctrinational work is being conducted on the ships and in the units. Here, we proceed from the proposition that the decisive force of the Navy consists of people who are boundlessly devoted to the party and the Soviet government, are skillfully mastering equipment and weapons, and are filled with the firm resolve to accomplish their patriotic and international duty on the motherland's first order. Great significance is attached to propagandizing the fleet's revolutionary and combat traditions--our mighty weapon in the matter of indoctrinating the seamen.

The naval personnel are persistently improving their combat skill. Long cruises have become the basis of combat training and a school of combat ability. Not only the reliability of the materiel, but also the moral-political and psychological tempering of the personnel and the ability to master equipment and weapons are checked namely on voyages of many days.

Well-trained personnel are the fleet's most valuable possession. Officers, primarily with a higher education who possess lofty ideological tempering and deep military and technical knowledge, skillfully train and indoctrinate their subordinates. The majority of the seamen and petty officers have a secondary and secondary technical education which permits them to master a specialty to perfection in short times. The number of experts, rated specialists, masters of military affairs, and men who are mastering several allied specialties on the ships and in the units is growing.

Our fleet is participating actively in the foreign-policy measures of our state and contributing to the conduct of a policy of friendship between

peoples. In recent years, the ships have made many official visits to foreign ports. The population of these countries could see with their own eyes the high level of naval ability and behavioral style of the seamen who are worthy of representatives of the first socialist power in the world.

The Navy is accomplishing its missions with honor within the framework of the Warsaw Pact Organization. Ties with the navies of the Polish People's Republic and the German Democratic Republic are constantly being strengthened. A broad exchange of experience in combat and political training is under way.

The inexhaustible source of the fleet's strength and might is in its inseparable and ever strengthening unity with the people. Close bonds of fraternal friendship link the men of the Baltic Fleet with the workers of Soviet Lithuania.

The Central Committee of the Lithuanian Communist Party, the Presidium of the republic's Supreme Soviet, the Council of Ministers, and the Komsomol Central Committee as well as party and soviet organs of Vilnius, Klaipeda, and other cities are rendering inestimable assistance to the fleet's command.

Surrounded by national concern and love, the Soviet Navy is standing guard over socialism's achievements in a single formation with the other services of the Armed Forces. The personnel are ready to reliably defend the honor, freedom, and independence of the beloved motherland with weapons in hand. The naval personnel are always on the alert, always in combat readiness. Today, their thoughts and deeds are directed toward a single goal--to greet the 26th CPSU Congress in a worthy manner.

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CSO: 1801

CIVIL DEFENSE: BASEMENT SHELTER CONSTRUCTION

Moscow PRISPOSOBLENIYE PODVALOV SUSHCHESTVUYUSHCHIKH ZDANIY POD UBEZHI-SHCHA (Adapting Basements of Existing Buildings as Shelters) in Russian 1971 signed to press 27 Jul 71 pp 1-3, 38-47, 100-112, 153-204, 207-208

[Annotation, table of contents, foreword, chapter 2, excerpt (pp 100-112) from chapter 6, and chapter 7 from book by Vladimir Il'ich Ganushkin, Vladimir Ivanovich Morozov, Boris Ivanovich Nikonov and Georgiy Ivanovich Orlov, 2d edition, revised and supplemented, Izdatel'stvo literatury po stroitel'stvu, 13,000 copies, 208 pages]

[Text] The book sets forth problems of adapting basements of existing buildings as shelters to provide protection for the population from the harmful elements of a nuclear explosion and also from the effects of chemical and bacteriological weapons. Estimated parameters of the harmful elements of a nuclear explosion are computed, an evaluation of the protective properties of enclosing structure is given and three-dimensional layout and constructional solutions for strengthening basement members and schematic diagrams for working out inside equipment systems are presented. Computation of the protective properties of constructional structure from the shock wave, radioactive contamination and heat from fires are illustrated by examples that use charts and tables.

The second edition includes new material that touches on questions of the design of protective civil defense structures, and individual chapters and paragraphs have been revised.

The book is intended for engineers and technicians who are engaged in the design of protective structures and for students of higher construction-education institutions and departments. The normative data cited in this book are not official.

Contents

Foreword

The Communist Party and the Soviet Government are steadily pursuing a policy of peaceful coexistence of states with different social systems. However, plans for attack on the socialist countries that the aggressive NATO command is perfecting forces us to constantly improve the country's defense capability and to manifest unremitting vigilance against the intrigues of the enemies of peace.

The threat of the use of nuclear, chemical and bacteriological weaponry in case of war compels the Soviet people not only to strengthen the combat capability of the Soviet Armed Forces but also to be ready for antinuclear, antichemical, antiradiation and antibacteriological defense.

The task of defending the population during a possible war can be solved directly by evacuating and dispersing it from the areas of possible enemy strikes and by providing cover in special protective structures (shelters and covers) for blue-collar and white-collar workers who have been left in the cities at vitally important facilities (defense facilities, industrial enterprises, transport, power-supply systems, communications, and so on) [54].

Various premises located in the basement and socle stories of buildings can be reequipped as shelters and cover. It is desirable, therefore, to envisage all the possibilities for adapting buried portions of existing

[54] Chuykov, V. I. "Nashe obshcheye delo grazhdanskaya oborona" [Civil Defense Is Our Common Cause]. NAUKA I ZHIZN', No 1, 1969.

buildings and structures in a short time to the protection of people. It can become necessary to use the stronger portions of existing buildings because in built-up urban areas and at industrial facilities there may be no areas free for the erection of shelters. Such a solution can be desirable also because of technical and economic considerations, when the facilities of the required strength in basements, shelters or covered installations will be cheaper than the construction of special protective structures.

The authors have set themselves the task of evaluating the protective properties of the enclosing structure of basements against the harmful elements of a nuclear explosion and, on that basis, of showing how, by executing minimal constructional measures, it will be possible to adapt existing basements as shelters that will provide reliable protection for people against modern means of destruction.

Chapters 1-5 and sections 10-11 of chapter 6 were written by V. I. Morozov, sections 1-9 of chapter 6 by V. I. Ganushkin, and chapter 7 by B. I. Nikonov and G. I. Orlov.

Chapter 2. The Requirements for Shelters and Basements Intended for Adaptation as Shelters.

1. The Protective Properties Required of Shelters

The requirements made on built-in shelters are determined on the basis of an assessment of the destructive elements of the nuclear explosion that was cited in chapter 1.

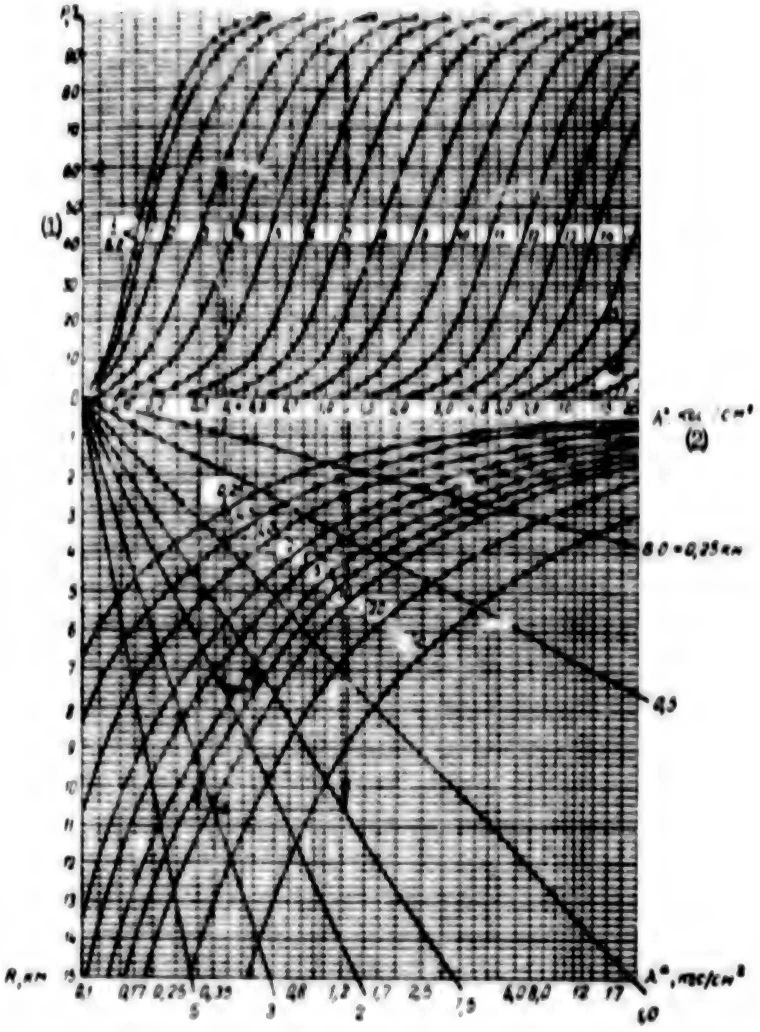
Enclosure structure for shelters should be designed for the effect of the shock wave of a ground-level burst of a nuclear weapon. The protective properties of shelters against the shock wave are established in each specific case to take account of the strength characteristics of the main load-bearing structure and the chosen method for reinforcing it, and also the yield of the nuclear weapon and the distance from the possible center of the explosion to the shelter. The degree of protection of the shelter from a shock wave λ can be found from the nomogram (figure 9) as a function of the estimated yield of the weapon and the prescribed reliability of the protection, which is determined in accordance with a known procedure [57]. The radii of destruction R_d in kilometers are laid out along the ordinate axis of the lower part of the nomogram in figure 9, and the pressure of the shock wave (the degree of protection of the structure) along the abscissa. Each curve in the lower part of the nomogram corresponds to the yield of a nuclear weapon. The numerical values of the weapon's yield have been given in megatons. The rays that lead from the point O

[57] Ponikarov, N. D., Chumakov, V. I. and Durikov, A. P. "Chto neobkhodimo znat' o yadernom oruzhii i zashchite ot nego" [What It Is Necessary to Know about a Nuclear Weapon and about Protection from It]. Atomizdat, 1965.

Figure 9. Nomogram for Determining the Radii of Destruction and Probability of the Occurrence of Various Pressures on the Ground During a Ground-Level Nuclear Burst (the nomogram was made up by A. I. Kostin).

Key:

1. V.O. [probable error].
2. Kg-force/cm².



correspond to the probable error (V. O.) in kilometers of the nuclear weapon from the aiming point. The upper part of the nomogram is a graph of the change of probability of destruction as a function of the ratios R_d/V. O. and ι/V. O., where ι is the distance of the facility (or structure) from the aiming point.

An example of determination of the probability of destruction of a structure with the degree of protection Δ = 0.5 kg-force/cm² that is ι = 6 km from the aiming point, where the weapon's explosion has a yield of 7 megatons and the probable error V. O. = 2 km, is indicated by the broken line.

It is possible, using the nomogram, to determine also the estimated size of a nuclear weapon that is proposed for striking some certain target. For example, if the assigned mission is to achieve a pressure of 0.3 kg-force/cm² on the outskirts of a community, where ι = 7.5 from the aiming point, with a probability of P = 90 percent, then, given a probable error V. O. = 1.5 km, the yield of the nuclear weapon should be about 8 megatons. This example has been depicted on the nomogram by the dot-and-dash line. The value for the size is found at the intersection of the horizontal and vertical line (coming from below).

A shelter should give protection from the initial (both gamma rays and neutrons) and residual nuclear radiation. The protective properties of

the shelters are, in this case, a function of the design and the density of the materials and the presence of an earth-n cushioning layer; in this case, protection from neutrons is more complicated than protection from gamma radiation.

The required ratio of weakening of the radiation by the enclosure structure of built-in shelters is a function of the estimated dose of the penetrating radiation, which is determined by the size of the nuclear weapon that is proposed for use in inflicting the strike on the city or industrial facility, and of the distance from the possible center of the explosion to the shelter. The distance can be found in accordance with the pressure on the shock-wave front against which the shelter should provide protection. Consequently, it can be said that the required attentuation ratio of the penetrating radiation depends upon the protective properties of the shelter against the shock wave and the estimated size of the nuclear weapon.

Since the irradiation energies of the initial and residual radiation are different, different protective masses are required in order to weaken them an identical number of times. The estimated dosages of these types of radiation against the protective cover also are different, so it is desirable to vary the attenuation ratio of the penetrating radiation and that of the residual radiation.

It is recommended that an attenuation ratio for residual radiation be adopted at 100 for covers [28]. In the FRG [29], 3,000 r/hr is adopted in determining the required attenuation ratio for shelters as the computed value of the reference level of radiation (in 1 hour after the explosion). Based upon this value of the radiation level and the permissible value of a biologically effective dose of 50 r's [9], where the occupants spend 2-7 days in a shelter, the required attenuation ratio for residual radiation is $K_o = 180$.

Gamma-ray and neutron doses during nuclear explosions 5 million tons or more in yield in zones with pressures of less than 2 kg-force/cm^2 do not present a danger to shelter occupants (see table 6 [not reproduced in this translation]).

Where the explosions are less than 5 million tons in yield, protection is required against penetrating radiation, the doses of which can exceed the lethal dose. It would be unwarranted to designate an attenuation ratio for penetrating radiation that is identical for explosions of all yields. They should be selected differentially, based upon the permissible dose

[28] Gorchakov, A. D., Zhukov, Yu. A., Koshelev, L. I., Rossal, N. A. and Khomko, A. A. "Prosteyshiye ukrytiya dlya zashchity ot oruzhiya massovogo porazheniya" [The Simplest Covers for Protection Against Weapons of Mass Destruction]. Stroyizdat, 1964.

[29] Dräger, Heye and Sackman. Der Grundschutz, Verlas, E. S. Mittler Sohn, G. M. B. H., Berlin-Frankfurt, 1962.

[9] Devidson, G. O. "Biologicheskiya posledstviya obshchego gamma-obllucheniya cheloveka" [The Biological Consequences of Human Whole-Body Exposure to Gamma Irradiation]. Atomizdat, 1960.

of penetrating radiation and the dose in an open place. If the permissible dose is taken as 20-30 r, then the attenuation ratio of the penetrating radiation should be no less than the values shown in table 12.

Table 12

Required Attenuation Ratio for Penetrating Radiation as a Function of the Degree of Protection of a Shelter According to the Shock Wave and Yield of the Explosion

Degree of protection of a shelter for a shock wave, in kg-force/cm^2	Required attenuation ratio of radiation where the yield, in thousands of tons, is				
	500	1,000	2,000	5,000	10,000
0.5.................	1	1	1	1	1
1..................	16	4	1	1	1
1.5................	120	30	7	1	1
2..................	330	120	30	3	1

Entrances to shelters should have that same degree of protection that the main premises have. An emergency exit must be built to allow evacuation of the occupants in case of possible destruction of the entrances and the blocking thereof by the debris of buildings.

Providing protection from heat radiation from fires that occur close to shelters or over them is an important requirement.

Each shelter should be equipped with ventilation equipment, sanitary-engineering devices and arrangements and equipment for removing toxic and radioactive substances, as well as bacterial aerosols, from the air.

The cooling of influx air should be specified for shelters located where massive fires and obstructions can occur, and the occupants should be protected from dangerous concentrations of carbon monoxide. This is possible only with the use of special industrial equipment.

Shelters that have been constructed in basements of existing buildings and structures can have:

1) Reinforcement structure made of long-lasting noncombustible materials (metal, cast-in-place or precast reinforced concrete, brick, rock and so on);

2) Reinforcement structure made of any material at hand, including wood;

3) Internal equipment made from industrial resources; and

4) Internal equipment of simplified type made from materials at hand, or made by the efforts of the populace and of local industry.

Choosing Premises for Adaptation as Shelters

The following buried portions of buildings and structures can be adapted as shelters:

1) The basement stories of production and auxiliary-production buildings and of administration and personal-services buildings at industrial enterprises that are used in peacetime as wardrobes, dining rooms, snack bars, showers, business offices, storerooms of various types and so on;

2) Freestanding buried structures intended for accommodating production or storage premises or premises for activities that serve the whole plant;

3) Pedestrian tunnels, ventilation galleries and tunnels, empty spaces at large footings under equipment, and so on;

4) The inspection galleries of hydroelectric power stations; and

5) Basements in apartment houses.

Premises and structures intended for adaptation as shelters should satisfy certain requirements.

The main structure (walls, ceiling-floors, columns and so on) of such premises should be incombustible, fairly strong and well preserved. The premises should, as a rule, be completely buried in the ground, for in this case it is simpler to solve the tasks of strengthening the load-bearing capacity of the walls against horizontal loads and of protecting against radiation. Semibasement premises, where the bottom of the ceiling-floor is raised no more than 0.8 meter above the leveled ground-surface grade may also be adapted as shelters. Where the bottom of the ceiling-floor is higher, solutions for reinforcing the walls are difficult and cumbersome. In order to accommodate occupants, shelters should have the necessary area free of equipment and should be of adequate height.

The industrial process that takes place in premises that are contemplated for adaptation as shelters should allow, in peacetime, strengthening reinforcement of the enclosure structure, an increase in its resistance to blast and penetrating radiation, and the closing up of industrial openings and orifices in the enclosing structure.

The premises selected should be on those sites of the locality that are not threatened by flooding by emergency water supplies or by storm water or ground water. There should not be any large tanks for liquids or water or sewer mains, whose destruction or damaging could threaten to flood [illegible] the vicinity of premises intended for adaptation as shelters. It is recommended that shelters not be sited in production buildings with industrial equipment that can cause vibration that can disturb the seal of the shelter or that gives off heat capable of heating the shelter's enclosure structure. Nor should shelters be sited on premises through which [illegible] for heating, water supply, compressed air, ventilation, gas,

steam and electric-power supply) pass, or where hanging racks and the horizontal portions of sewerage systems have been placed. Destruction or damaging of pipelines of the various systems can create additional danger to the lives of shelter occupants. When the placement of shelters in premises where various service and utility lines pass is compulsory and the removal of these lines is impossible, steam lines no more than 50 mm in diameter, gas lines no more than 40 mm in diameter, and water-supply and heating lines no more than 70 mm in diameter may be left within shelters. Devices that enable shut-off of the lines from internal and outside grids should be installed within shelters where pipelines are allowed to remain.

Sewerage risers within a shelter should be enclosed in metal pipes or in reinforced-concrete conduits firmly fixed to the ceiling-floors and floors.

There should be no unusually heavy items and equipment in premises located directly over a shelter.

Routes of approach to shelters in buildings should be as free as possible of hanging decorative items and combustible or heavily-smoking materials.

Premises that are located in category 3 fire-hazard districts or in fire-free zones should be selected as shelters. In these cases, the process of treating the outside inflow air is simplified, and, in particular, the need for special filters in the ventilation system to remove carbon monoxide from the air is done away with.

Preference also should be given to premises that are situated in buildings where people who are to be sheltered stay all the time. In this case, the time lost that potential shelter occupants spend in passing from where they stay all the time to the shelter entrance should satisfy the proviso

$$t_{evac} + t_0 \leq T, \qquad (22)$$

where T is the permissible time for filling the shelter, in minutes;
t_0 is a constant that is a function of the group of people who are to be sheltered and the place they are to be found at the time the air-raid alarm (VT) is sounded, in minutes; and
t_{evac} is the time spent en route to the shelter by the people who are the greatest distance away, in minutes.

The amount of permissible time for filling the shelter should be prescribed in each specific case.

The constant t_0 comprises the time needed by a shelter occupant to assemble after the VT signal (interpretation of the VT signal that has been heard, dressing, assembly of the necessities, the turning off of industrial equipment, and so on), the time of movement of the last man in the shelter entrance, and the time spent closing the shelter's doors.

An approximate average time for this constant can be assumed to be $t_0 = 30$ minutes for the operating personnel of enterprises and institutions, and $t_0 = 8$ minutes for the populace in housing rayons.

The time spent en route to the shelter by people who are at the place most distant from the shelter is determined according to the formula

$$t_{evac} = \frac{3h(n-1)}{v_л} + \frac{\Sigma \ell_i}{v_г} \text{ min,} \tag{23}$$

where h is the height of a story, in meters;
n is the number of stories;
$\Sigma \ell_i$ is the length of the horizontal paths within the building, in meters;
$v_г$ is the average speed of movement of people along the horizontal path, which is assumed to be 70 m/min; and
$v_л$ is the average speed of movement of people along stairways, which is assumed to be 25 m/min for housing rayons and 15 m/min for industrial facilities.

When choosing as a shelter a place outside a building where the people concerned regularly spend their time, the distance from the exit of the building to the shelter entrance should not exceed the radius of assembly R_{as}, the value of which is determined in accordance with the formula

$$R_{as} = 70[T - (t_{evac} + t_0)] \text{ m.} \tag{24}$$

When premises and structures are being adapted as shelters, the following basic work should be accomplished:

1) Reinforcement of the load-bearing structure if it does not possess adequate protective properties;

2) The covering over of openings and orifices in the enclosure structure that are not needed for shelter operation or for peacetime operations;

3) The sealing of the enclosure structure and of the entrances of facilities (the closing off of cracks, the sealing of places of passage of the various utilities and service lines and places of abutment of door frames to the walls, and so on);

4) The construction and installation of internal and domestic-services equipment;

5) The construction of protected entrances and emergency exits;

6) The execution of measures for the construction and the protection of air intake and exhaust openings from the effects of the shock wave; and

7) The execution of measures that will insure rapid, accident-free stopping of the industrial equipment and the bringing of the shelter up to combat readiness.

In adopting production and operating premises as shelters, reinforcement structure and the internal equipment should not significantly impede the use of these premises and structures for their main purpose or prevent restructuring of the operating process.

3. The Procedure and Methods for Making a Survey of Basements

In order to resolve the question of whether some particular basement can be adapted as a shelter, it is inspected with a view to determining to what extent the requirements made on such premises are satisfied.

During a survey of basements, the existing structural members are examined and measurement sketches are made up (if there are no blueprints), with an indication of all the clearance sizes of the basement and of various parts of its structure (beam span, column spacing, basement height, and so on).

In examining a basement it is necessary to find out:

a) The constructional scheme of the basement story and the material of the load-bearing structure;

b) The system for transmitting loads;

v) The condition of the ceiling-floors, walls, columns, piers and their joinings;

g) The condition of welded joints and of support members in steel structure;

d) The condition of the footings and a determination of their actual sizes.

Special attention should be paid to the cross-section of structural members, and also to the cross-sections of primary reinforcements and their placement and condition (the degree of damage by corrosion).

In order to determine the cross-section of a primary reinforcement, it is necessary to remove the protective concrete layer in various places and to bare the bars of the existing reinforcement to half their cross-section. The protective layer of the concrete is removed by means of a chosen and stone-hammer or with some kind of mechanical tool (electric hammer and so on).

The load-bearing structure is carefully examined, since there can be damage in the form of cracks in the beams. Sections of concrete structure that are damaged by pitting must be found. Sections with concrete that

has lost strength are detected by a dull sound when struck with a hammer. Concrete that has lost strength or been damaged by pitting should be replaced.

A report is made up on the results of the inspection of a basement that indicates the peacetime designation of the premises and to what degree the inspected premises satisfy the requirements laid on shelters.

Appended to the report are:

The plan and elevations of the basement with an indication of the entrances and exits, and places of entry of pipelines for heating, water supply and sewerage and of cables for electric power and communications;

The blueprints (or measurement drawings) of the load-bearing and enclosure structure;

A listing of defects that mark the condition of the structural pieces;

A table of values of the loads on the ceiling-floor imposed by equipment located above the basement;

Climatological data;

The district's master plan;

An evaluation of hydrogeological conditions; and

An explanatory memorandum.

Chapter 6. Three-Dimensional Layout and Constructional Solutions for Reinforcing Various Members of Basements Adapted as Shelters.

1. Three-Dimensional Layout Solutions

The three-dimensional layout solutions of the basements of housing and public and industrial buildings and of separate buried structures of various types are extremely diverse. They depend to a great extent upon the three-dimensional layout and constructional solutions of the surface portions of the buildings and the nature of use of the premises (or structures) in peacetime.

The main parameters that characterize the layout solution complex for a basement (or structure) as a whole are the span, that is, the distance between enclosing or load-bearing walls (or columns), the presence within the premises of various types of divider walls, and the location and number of entrances.

Existing basements (or structures) can be arbitrarily subdivided according to their constructional and layout solutions into:

a) Basements of industrial-enterprise production buildings; in plan, the columnar network with spacing of 6x6 meters is the main layout cell of the solution; the height of the premises is 3 to 5 meters or more;

b) Tunnels for operating purposes with span of 1.5 to 3.5 meters and a height of 2 to 3 meters; the length of a tunnel can be up to 100 meters or more;

v) Basements for housing and social buildings, as well as administrative and personal-services buildings of industrial enterprises. For buildings with load-bearing longitudinal walls, the size of the premises in plan (in width) is about 6 meters, and in length it is 16-18 meters (or the distance between staircases). In buildings with lateral load-bearing walls, the spacing of the permanent inside walls is 2.6-3.2 meters. The premises are about 12 meters long. The height of the basement does not, as a rule, exceed 2 meters.

g) City pedestrian crossings; their spans can vary from 3 to 8 meters, heights from 2 to 3 meters, lengths from 30 to 100 meters; and

d) Empty spaces in massive footings, inspection galleries at hydroelectric power stations, and so on: the sizes of these premises depends upon the specifics of the operating equipment, and the length and design of the dams.

As has been pointed out already, buried premises (or structures) are used in most cases for different types of personal-services, economic and production needs.

Basements of production buildings can house departments with fixed-temperature regimes and storage for raw materials, semifinished items, finished output, tools, and so on. Machine tools and other operating equipment can be located in some premises, so the areas to be protected are, as a rule, being used incompletely (by 60-70 percent on the average). The total area of basements under buildings varies from 50 to 1,000 square meters or more.

Operations tunnels intended for inter- and intradepartmental transporting of raw materials, fuel and finished products are being used as pedestrian tunnels and crossings, and also as ventilation and air-intake galleries.

Offices, storerooms, personal-services facilities, snack bars and so on are being sited in basements of housing and social buildings, as well as in the administrative and domestic-services buildings of industrial enterprises. The adaption of existing basements as shelters should not preclude their normal functioning for their primary purpose, except for cases specified by a concrete program, and particularly where work is performed for limited periods of time.

The adaptation of basements (or structures) often necessitates changes in existing three-dimensional layout and constructional solutions. These are occasioned by the requirement to provide shelters with special premises and to reinforce existing structure.

The additional layout and constructional changes to be accomplished should be mutually coordinated, simple and economical.

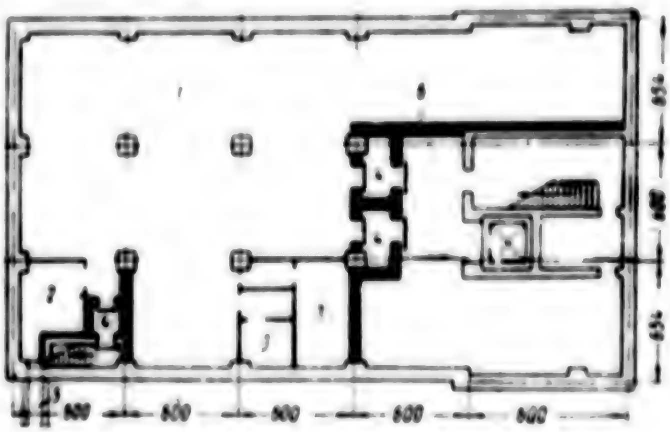
Basements that are to be adapted as shelters should have the following premises: a) for the persons to be sheltered; b) for ventilation and filtration equipment (and also, if required, for diesel equipment); and v) for rest rooms.

Shelters should be equipped with: a) protected entrances with the installation of antechambers; b) emergency exits; and v) air locks (with concurrence of local CD staffs).

Examples of layout solutions for adapting premises of various types of shelters are shown in figures 23-26.

Figure 23. Layout Solution of an Industrial-Building Basement Adapted as a Shelter.

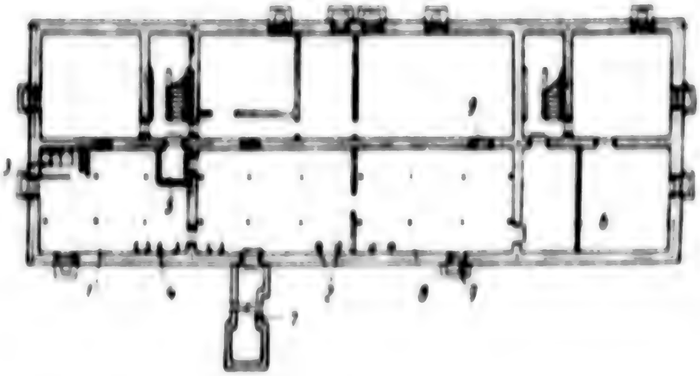
Key:
1. Place for those to be sheltered; used as a materials storeroom in peacetime.
2. Ventilation-filtration chamber.
3. Rest rooms.
4. Antechambers of entrances.
5. Emergency exit.
6. Newly erected structure, and structure for reinforcement of the existing walls.



Most suitable for adaptation are premises that are not stuffed with different kinds of industrial equipment and that have much free space. If placing the special premises required for shelters within the existing dimensions of buildings is difficult, the shelters may be added onto the basic structure as annexes (see figure 28).

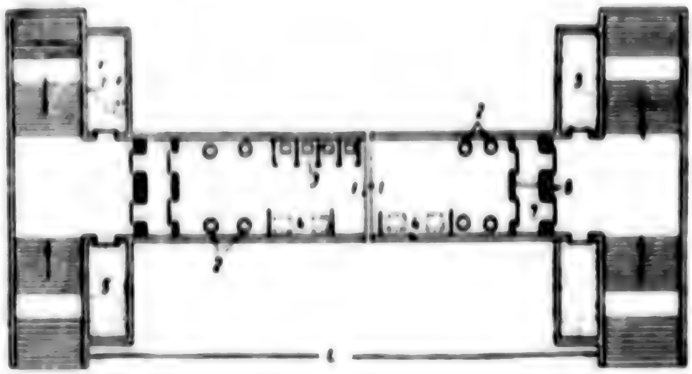
Benches for sitting and platforms for lying down are installed in shelters to accommodate the occupants. Platforms for lying down, if the height of the adapted premises permits, are installed on a double tier. The dimensions of the domestic-services equipment are adopted on the basis of 0.45x0.45 meter per place for sitting and 0.55x1.8 meters per place for lying down.

Figure 24. Layout Solution of an Apartment-House Basement Adapted as a Shelter.



Key:
1. Premise for those being sheltered.
2. Ventilation-filtration chamber.
3. Rest rooms.
4. Place for water container.
5. Antechambers for entrances.
6. Airlock.
7. Emergency exit.
8. Structure for reinforcing the ceiling-floor.
9. Closing off of light openings and doors.

Figure 25. Layout Solution for City Pedestrian Tunnel Adapted as a Shelter.



Key:
1. Tunnel used as a shelter.
2. Coupled bellows-bag installation.
3. Powder-closet.
4. Place for water containers.
5. Sand filter.
6. Protective structure for entrances.
7. Antechamber.

L. Length of tunnel.

Domestic-services equipment should be installed to consider the potential for free movement of people about the shelter while it is being filled with occupants and during their stay there.

The width of the passages--70-95 cm--is set as a function of the nature of the premises' domestic-services equipment (figure 27).

Heavy, fixed, stationary equipment, for example, various sorts of machine tools and conveyors that cannot be disassembled, stacks of finished goods, and so on, reduce the effectiveness of use of the premises' area, hampering the installation of domestic-services equipment, as a result of which the shelter's capacity is reduced and expenditures for adaptation per occupant are increased. Research and calculations performed have shown that expenditures per occupant can be increased from 20 to 50 percent as a

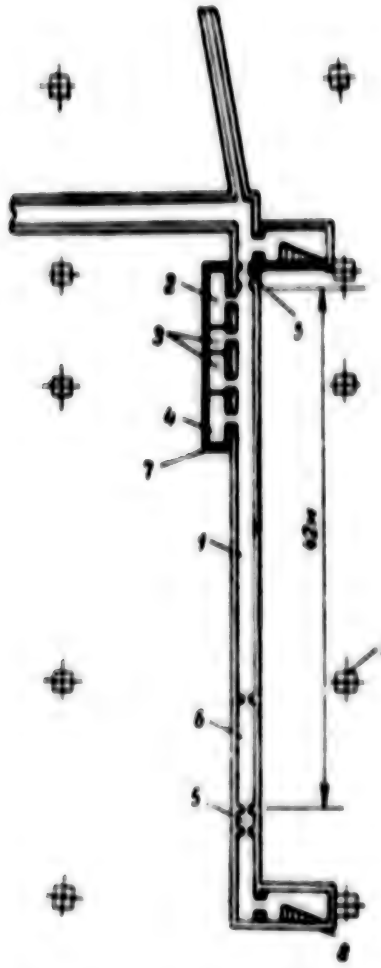


Figure 26. Layout Solution for Adapting an Operations Tunnel as a Shelter

Key:
1. Premise for those being sheltered.
2. Ventilation-filtration chamber.
3. Rest rooms.
4. Storeroom.
5. Antechamber.
6. Air lock.
7. Newly erected structure.
8. Entrances from enterprise's production department.
9. Columns of the department.

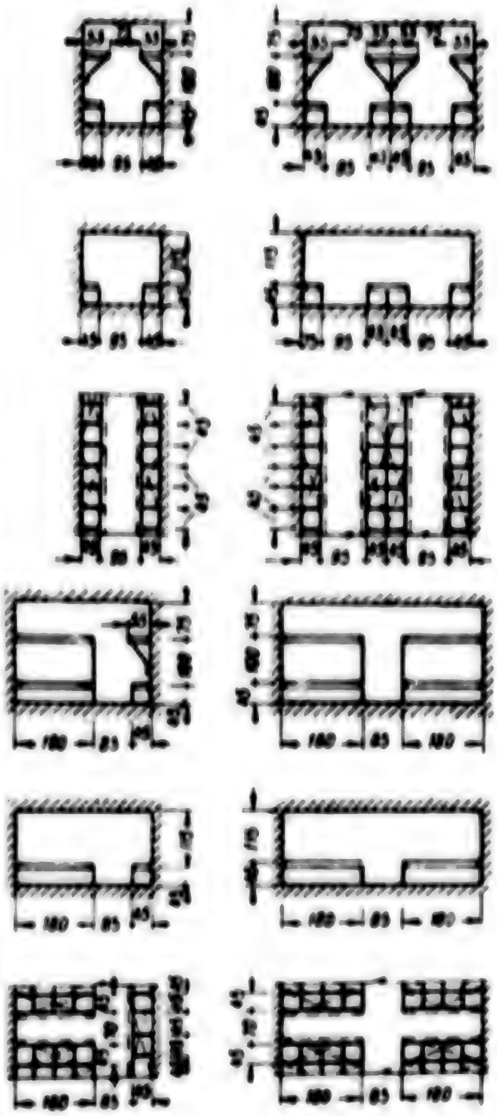


Figure 27. Methods for Distributing Bunks and Places for Sitting.

result of this. Therefore, it is recommended that maximum use be made of existing equipment and materials for the occupants sheltered there.

The ventilation and filtering equipment of a shelter is situated, as a rule, in an isolated premise. The diesel plant should be situated outside the line of sealing and separately from other shelter premises. An

antechamber is installed at the entrance to the diesel plant. It is recommended that the ventilating and filtering premise be situated by an outside wall of the basement, together with the emergency exit from the shelter. The end piece and gallery of the emergency exit can be used as an air-intake structure.

Where there is no distribution network, the ventilation and filtration equipment is located in the same premises as the occupants. The rest rooms in this case are built at as great a distance as possible from the fans.

In order to adapt a place as a shelter, maximum use must be made of existing sanitary-engineering components and of entrances, since installing them all over again is extremely labor intensive. Additional entrances that are to be built are placed, as a rule, adjacent to the basement's outer walls. It is recommended that a light overhang be built above the stairflight to protect the entry from atmosphere effects. Entrances to shelters are equipped with antechambers. The sizes and number of existing and additional entrances needed for filling the shelters should be designated in accordance with the requirements laid down in section 10 of this chapter [not included in this translation].

The surface structure of buildings and structures will, as a rule, be destroyed by the effect of the shockwave of a nuclear explosion. It is not precluded that entrances into the shelters also will be partially destroyed or obstructed by debris from buildings. Therefore, special emergency exits are required for the unimpeded exit of people from shelters after a nuclear blow is struck. The structure of the emergency exit should possess a load-carrying capability not lower than that of the shelter's enclosure structure, and its length and the design of the end piece should allow occupants to exit to unobstructed ground or to the surface of the presumed obstruction. In general, the layout and constructional solution for adapting premises as shelters should pay serious attention to the arrangement of air locks. These air locks are a special premise provided at the entrance to the shelter, which are intended for filling the shelter with occupants, not gradually but in definite time intervals. The enclosure structure (walls and ceiling floors) of the locks should possess the same protective properties as the structure of the shelter. Sealed protective doors should be installed at the entrance to the air lock and the exit therefrom into the shelter. It is proposed that the lock operate according to the following scheme. The air lock fills with people when the outer doors are open and the doors installed in the wall that separate the lock and the premises of the shelter are closed. Then the outer doors are closed and the doors leading into the shelter are opened. The people pass into the shelter, then the inner doors are shut and the outer doors are opened, and so on.

After the shelter is filled, the air lock can be used as a place for sheltering people. The presence of the locks enables a definite guarantee of safety for the people already inside the shelter if a surprise nuclear blow is struck, and it also enables the shelter to be filled over a long period of time.

Light openings and industrial openings that exist in the basement's enclosure structure should be protected from the effects of the shock wave and of penetrating radiation. Those openings without which the premises can be operated in peacetime should be filled in, in advance, with brick, concrete or other materials, with provisions for the necessary bond between the new and the old structure. Other openings should be prepared for rapid closing with special metal shutters or prefabricated reinforced-concrete members.

If there are areaways by the openings, they are backfilled with soil.

2. Principles and Methods for Reinforcing Existing Structure

The reinforcement of existing structure for added strength should be solved in integrated fashion, with reinforcement thereof also against the effects of penetrating radiation and thermal effects from fires.

The methods of reinforcement must be fairly simple and effective and require a minimum amount of materials and expenditure of time.

Raising the load-bearing capability of existing structure can be done without change or with change in the constructional scheme of its working. In the first case this can be accomplished by increasing the operating weight of the cross-section of reinforced concrete, concrete and stone structure with a layer of cast-in-place concrete, with reinforcement of the structure, and by increasing the structure's lateral cross-section by welding on additional members made of H-beams, channel iron, angle iron, and so forth. Such a method can be recommended for raising the load-bearing capability of the structure at least two-fold to three-fold.

An increase in thickness of the structure is extremely effective in reinforcing members in central or eccentric compression with small eccentric systems. The reinforcement of reinforced-concrete ceiling-floor structure by means of yokes that Engineer I. M. Litvinov proposed has been widely used in domestic practice. The essence of this method consists in increasing the height and width of the structure to be reinforced (from below, from the sides, or from on top of the cross-section being reinforced) with an increment of reinforced concrete. In this case the bond between the old and the new reinforced concrete is made by the transmittal of all the tangential stresses at work in the plane of the joining of the new concrete to the old onto a special reinforcement that is welded to the existing reinforcement of the structure that is being further reinforced, which is first stripped at the points of welding. This method is used most often when reinforcing reinforced-concrete beams.

The use of yokes requires insignificant consumption of materials, preserves the useful area of the premises, and, as a rule, does not hinder the industrial process in the structures (except for the period when the reinforcement work is being done). However, this method also has deficiencies. The process associated with baring the existing reinforcement and overhead welding of the new, additional bars, gives rise to a number of

inconveniences and requires substantial expenditure of time. Moreover, a sharp rise in the load-bearing capability of the structure with the use of this method of reinforcement is fairly difficult. Thus, for example, in order to double the load-bearing capability of the member being reinforced requires that the height of the beam be increased by about 30 percent.

An increase in the area of a reinforcement in the tensioned zone of the cross-section of a flexural reinforced-concrete structure should not exceed its limiting value, which is characterized by the moment of onset of brittle destruction. This is determined by the appropriate standard indices, in accordance with an analysis of the design of the protective structures.

A general requirement for the installation of prefabricated monolithic ceiling-floors is that the required bond of the new concrete with the old be provided for. Laying the monolithic concrete should be preceded by a cleaning of the surface of the existing concrete of refuse and dirt, the treatment thereof with metal bristles or with sandblasting equipment, and washing with a stream of water under pressure. If the surface of the old concrete is impregnated with oil or is greatly contaminated and it is impossible to insure a coupling with the new concrete, the newly laid layer is treated as a separate reinforced-concrete slab that is reinforced both in span and at the supports and works jointly with the existing layer. In this case, the load-bearing capability of the reinforced-concrete structure is considered equal to the total of the load-carrying capabilities of both slabs, and the load is distributed proportionally to their stiffnesses [16].

Recently, polymer materials that increase the strength of structural pieces and improve the seal and waterproofing of structures have been used with increasing frequency in construction in the USSR and abroad.

Mastics based on epoxide resins, which are characterized by high static and dynamic strength and physico-chemical stability, are of the greatest interest [59, 60]. Glues based on epoxide resins can be used both to strengthen the bond of old concrete to new but also to glue various materials (metal, concrete, fiberglass fabric) to the structural piece that is being reinforced.

Static and dynamic tests of reinforced-concrete structure that has been further reinforced against a bending moment and lateral and normal forces

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[16] Sakhnovskiy, K. V. ZHELEZOBETONNYYE KONSTRUKTSII [Reinforced-Concrete Structure], No 8, 1961, Gosstroyizdat

[59] Mikul'skiy, V.G. and Igonin. "Stsepleniye i skleivaniye betona v sooruzheniyakh" [The Coupling and Gluing of Concrete in Structures]. Stroyizdat, 1965.

[60] Viktorov, V. V., Kozlov, V. V. and Mikul'skiy, V. G. "Prochnost' i deformativnost' epoksidnykh kleyev pri kratkovremennykh dinamicheskikh nagruzkakh" [The Strength and Deformability of Epoxide Glues under Short-Term Dynamic Loads]. BETON I ZHELEZOBETON, No 7, 1968.

by epoxide gluing of reinforced-concrete member, metal strips, rod-shaped reinforcement and fiberglass fabric have established that glued joints provide reliable joining of structure that is being reinforced with the reinforcing members and compatibility of their working with the indicated types of stressed state.

The use of epoxide glues for further reinforcement of reinforced-concrete structure reduces substantially the labor intensiveness of adapting premises as shelters.

Another method for increasing the load-bearing capability of enclosing rock, concrete, reinforced-concrete and metal structure is change of the original constructional scheme for their working by the installation of additional intermediate supports in the span or change of the deformation-stressed state and the conversion thereof into prestressed strut-framed systems.

The installation of additional supports, that is, a reduction in the span of the structure being reinforced, sharply raises its load-bearing capability. Thus, for example, with the span cut in half, its load-bearing capability is increased 4-fold. Still more effective is the combined method of reinforcement that calls for a reduction of the span with the simultaneous monolithing of the structure with concrete and the installation of additional superstructure reinforcement. In this way, single-span structure can be converted into multispan continuous structure, the computed bending-moment values in the spans having been greatly reduced thereby. It is extremely important to check the members being reinforced for the effect of lateral force. The danger of destruction of the structure along diagonal cracks comes from both an increase in the active load and a change in scheme of the working of the member.

Figure 28 shows the values of the computed bending moments M in a beam with a span ℓ that is subjected to a uniformly distributed load ($\Delta p + q$), which is reinforced by adding intermediate supports and is converted into a two-span or three-span continuous structure. The use of this method of reinforcement depends upon the potential for the installation of additional supports in the premises being adapted as a shelter.

If, for various reasons, the installation of uprights inside the premise is not permitted, then in some cases it is possible to put a thick, high-capacity purlin under a row of beams, resting it directly on the walls or other supports. When the presence of reinforcing uprights can impede the normal industrial process, the beam is reinforced with horizontal and strut-framed tie beams.

Curves of moments from the effects of constant (q) and temporary (Δp) loads and of the total curve that is obtained as a result of the reinforcement of a reinforced-concrete beam by a horizontal tie-beam are constructed in figure 29.

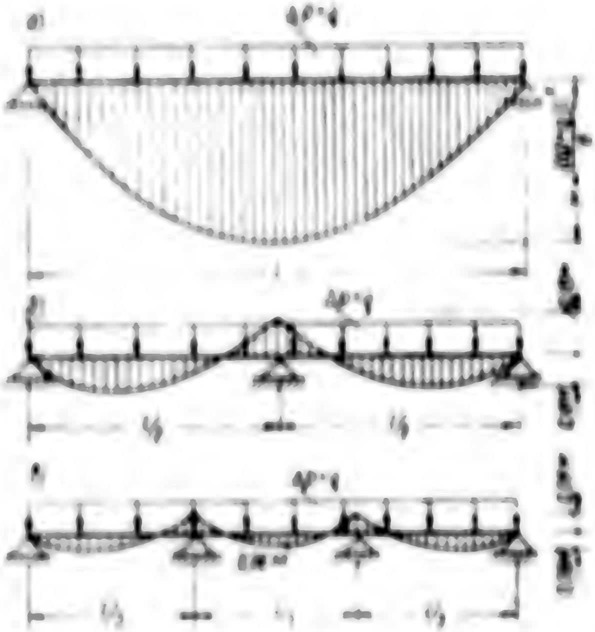


Figure 28. Schemes for Computed Bending Moments When One-span Structure Is Reinforced by Converting It into Two-span or Three-span Structure.

Key:
а. Structure prior to reinforcement.
б. Two-span structure.
в. Three-span structure.

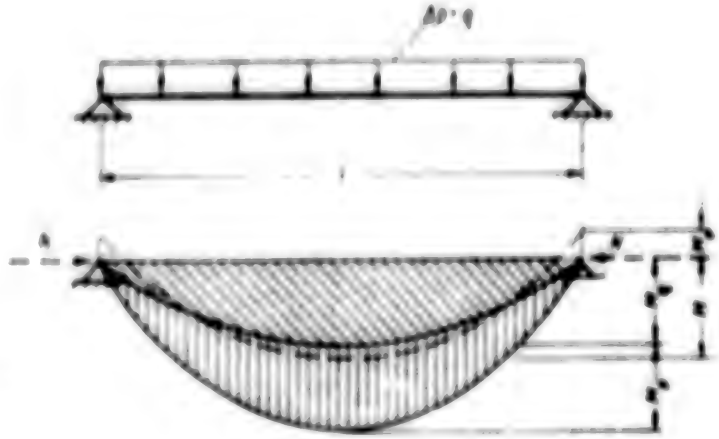


Figure 29. Scheme for Computed Bending Moments When a Structural Piece Is Reinforced by a Horizontal Tie Beam.

Key:
M_q is the moment from the constant load.
M_p is the moment from the temporary load.
M is the moment in the structural piece after it is reinforced for the effect of the permanent and temporary loads.
M_n is the moment that arises on the support from tensioning of the horizontal tie beam.
N is the stress in the tie beam.

The analysis and design of reinforcing members by different kinds of tie beams were examined in adequate detail in the works of N. M. Onufriyev [33] and M. N. Lashchenko [34].

[33] Onufriyev, N. M. "Prostiye sposoby usileniya zhelezobetonnykh konstruktsiy promyshlennykh zdaniy" [Simple Methods for Reinforcing Reinforced Concrete Structure of Industrial Buildings]. Gosstroyizdat, 1958.
[34] Lashchenko, M. N. "Usileniye metallicheskikh konstruktsiy" [The Reinforcement of Metal Structure]. Gosstroyizdat, 1954.

Chapter V. Systems and Elements of Internal Equipment for Basement Shelters.

1. General Requirements.

Internal equipment is intended to provide for the collective protection of the occupants of and to maintain tolerable sanitary and hygienic conditions in the shelter.

In resolving questions of internal equipment, all the harmful effects of modern weapons and the situation that arises within the zone of destruction, as well as the climatic conditions of the region and the capacity of the shelters, must be considered.

In a future war, the use of chemical substances and bacterial agents [54] in addition to nuclear weapons, is possible, so the complex of interior equipment of shelters should include elements that provide antichemical and antibacterial protection as well as antinuclear protection.

The probability that the external city (or facility) systems for water supply, sewerage and electricity will be put out of operation by a nuclear explosion makes it necessary to establish in shelters emergency supplies of water, to construct in them special containers for the reception of fecal sewage, to use equipment with manual drive, to require emergency lighting, and so on.

High levels of radioactive contamination in the locality and large-scale fires and obstructions require the conduct of large-scale emergency-rescue work. The occupants will not be able to vacate the shelter for several days, which also must be considered in choosing resources for internal equipment.

Air-supply, water-supply, sewerage and electrical systems, and means for protecting air intake and exhaust openings are included in the interior equipment for premises adapted as shelters. Moreover, when adapting basements as shelters ahead of time, it is desirable, with a view to preserving them in peacetime, to arrange for a central heating system. Shutoffs should be installed at heating-system inlets inside the shelter that will enable the intakes to be shut off while the shelter is being filled with people in wartime.

In order to avoid the warming of enclosure structure in peacetime, the use of panel heating, with monolithic supports and heater elements, is not desirable in shelters.

Shelter equipment should, as a rule, be produced by industrial manufacture. Special ventilation and filtering arrangements that provide protection

[54] Chuykov, V. I. "Nashe obshchee delo grazhdanskaya oborona" [Civil Defense Is Our Common Cause]. NAUKA I ZHIZN', No 1, 1969.

from radioactive dust, toxic substances and bacterial agents should be used when supplying air to shelters.

Where there are no funds for the industrial production of equipment for basements adapted as shelters that are located in category 3 fire-hazard districts and in fireproof areas, equipment can be made with materials at hand.

Decisions on equipment for shelters should call for maximum use of existing sanitary-engineering equipment in basements being adapted and should permit the operation of additional installed equipment in peacetime.

It is desirable in some cases to build centralized protected systems for supplying electricity and air to a group of closely situated shelters.

For purposes of communicating with the command post, a subscriber phone of the city telephone network and a loudspeaker that is plugged into the city or local (facility) radio rebroadcast network must be installed in premises adapted as shelters. Telephone communications should be accomplished by underground cable.

Interior equipment should be installed simultaneously with the general construction work in a sequence that will enable use of the premises for protecting people at any stage of work performance. The equipment should be placed to take convenience of operation into account.

7. Requirements for Sanitary and Hygienic Conditions in Shelters

The factors most important in determining sanitation and hygienic conditions (livability) in shelters are the temperature and moisture parameters and the air's gaseous content.

It is known that a sharp change in air-environment parameters is observed when a large number of people are placed in a sealed premise. These changes, which are expressed by a rise in temperature and humidity of the air, an increase in the carbon dioxide content, a reduction in the amount of oxygen and an accumulation of foul-smelling substances, can lead to a deterioration of the shelter occupant's feeling of well-being and to more serious consequences.

A knowledge of the nature of change in the air's parameters will enable questions of how long people can stay in shelters and the rational choice of internal equipment to be solved. At the same time, inadequately substantiated requirements for air parameters can make the equipment much more complex and expensive, since providing for the feed and purification of outside air or for processing inside air under shelter conditions cause substantial engineering difficulties and expenditure of funds.

Maintenance of the necessary habitability conditions in shelters acquires special importance when the sheltered persons stay there a long time.

As a result of numerous studies conducted here and abroad, it has been established that a rise in the concentration of carbon dioxide in the air seriously affects the human body. Thus, with a 2-percent CO_2 content, breathing becomes deeper; a protracted stay in an atmosphere that contains 3.5 percent CO_2 greatly worsens a person's physiological functions. Where the air contains 4 percent carbon dioxide, headache and chills appear [41]. A rise in respiration intensity is accompanied by an intensification of cardiac activity and a reduction in work capability. According to the data of such research, a 4-percent CO_2 content can be endured for only a short time, causing the appearance of severe poisoning. With a rise in CO_2 concentration to 8 percent, a reddening of the face, an appreciable slowing down of the pulse, heart palpitations, and dizziness are noted [42]. An 8-percent concentration of CO_2 can be endured for only 30-40 minutes. Where the stay in shelters is long, the maximum permissible concentration of carbon dioxide is assumed to be 1.5-2 percent. When shelters convert to a full isolation mode, a short-term rise in CO_2 content to 3-3.5 percent is permitted.

CO_2 concentration reaches its maximum values before the oxygen content is reduced to a dangerous level.

Research has indicated that a man can survive for a certain time in an atmosphere that has an oxygen content substantially below that of normal air. Thus, a 15-percent concentration of oxygen in the air breathed does not cause a rapid negative reaction of the body. Only an extraordinarily sharp reduction of oxygen (down to 10 percent) brings serious physiological changes and a person dies.

No less a danger for sheltered persons is a rise in temperature and humidity of the air. The difficulty of man's stay in an enclosed space with an increase in humidity and temperature is explained by the fact that when there is insufficient evaporation of water (perspiration) from a person's skin surface, heat regulation is upset.

According to the physiologists' data, a disturbance in heat exchange between a person's body and the environment sets in at temperatures above 30 degrees C. Man's endurance limit for high air temperature changes as a function of its humidity. With a rise in the moisture content of the air, man's capability to endure a high temperature is decreased.

Humidity that exceeds the 70-75 percent limits has an especially unfavorable effect on the human body when the air temperature is 30 degrees C. or higher.

The upper limit of heat equilibrium of a person who is in relative repose is, according to available data, a temperature of 30-31 degrees C., with a

[41] "The Effect of Oxygen Depletion and Fire Gases on Occupants of Shelters." NAVY CIVIL ENGINEER, Vol 3, No 1, 1962, pp 29-33.
[42] Krotkov, F. G. "Uchebnik voyennoy gigiyeny" [A Textbook of Military Hygiene]. Medgiz. 1962.

relative humidity of 85 percent, or 40 degrees C where the relative humidity of the air is 30 percent.

The USA's National Bureau of Standards, which has studied the temperature-humidity regime in concrete antiradiation shelters, indicates a temperature of 31.1-32.2 degrees C as an upper temperature limit at which people can stay in a shelter when the air is saturated with moisture for a period of a few hours, or 27.2-30 degrees C for a stay of 10 days [44].

In the Federal Republic of Germany, the upper limit for a rise of temperature in a shelter is assumed to be 29 degrees C [41].

An evaluation of the effect of heat and moisture parameters of the air on people in a shelter, according to foreign press data, is shown in table 25.

Table 25

The Effect of Heat and Moisture Parameters of Air on Persons in Shelters

Air temperature, in °C	Relative humidity,%	Evaluation of effect of temperature and moisture parameters
21-24	30-70	A perception of comfort.
29	90	A sensation of not feeling well.
30-32	90	Markedly unpleasant feelings, weakness, labored breathing, anxiety.
33	90	Dangerous rise in body temperature, rapid pulse, rapid breathing.
37	95-100	An extraordinarily dangerous and rapid rise in body temperature

It is more desirable to evaluate and compute the heat and humidity parameters of the air according to effective temperature T_{eff}, which characterizes the total effect of temperature and humidity of the air on a person.

By effective temperature is meant a temperature of practically motionless air of 100 percent relative humidity that creates, as observations indicate, the same perception of heat or cold that another combination of temperature and relative humidity of the air creates.

On the basis of the data cited, and also considering that children and people of advanced age who are burdened by various illnesses may be staying in a shelter, an effective temperature equal to 27 degrees ET can be considered as the maximum permissible heat and humidity parameters for the air for a stay of several days.

In special cases, for example during a build-up of fires, a short-term rise in effective temperature up to 29.5 degrees ET is possible. In southern regions, considering the acclimatization factor, an effective temperature of 29-29.5 degrees ET can be allowed, even for a lengthy stay in a shelter.

[44] Jagloy, C. P. "Limits for Cold, Heat and Humidity in Underground Shelters." ARCHIVES OF ENVIRONMENT OF HEALTH, No 2, 1961, pp 110-115.

[41] "The Effect of Oxygen Depletion and Fire Gases on Occupants of Shelters," NAVY CIVIL ENGINEER, Vol 3, No 1, 1962, pp 29-33.

Dry-thermometer temperatures and humidity values that correspond to effective temperatures of T_{eff} = 27 and 29.5 degrees ET are shown in table 26.

Table 26

Values of Temperature and Relative Humidity of the Air That Correspond to 27 and 29.5 Degrees ET

T_{eff} = 27° ET: Temperature, °C	T_{eff} = 27° ET: Relative humidity, percent	T_{eff} = 29.5° ET: Temperature, °C	T_{eff} = 29.5° ET: Relative humidity, percent
27	100	29.5	100
28	85	30	96
29	75	31	90
30	66	32	75
32	46	35	50

In order to analyze air supply systems and to choose the capacity and type of installation for an air regeneration and cooling mode, the norms for liberation of heat, moisture and carbon dioxide and the absorption of moisture of a person must be known, in addition to the permissible air parameters.

The intensity of the oxidizing processes that occur in the human body depend upon numerous factors, the most important of which are: environmental conditions and the person's state (repose, carrying out mental or physical labor, and so on).

According to OST 823 [All-Union Standard No 823], adults in a state of repose under normal environmental parameters liberate 75 kcal/hr of heat, children 50 kcal/hr. According to the data of physiologists, heat liberation of people in a state of repose is about 1 kcal/hr per kg of weight [43].

The handbook guide on heating and ventilation (USA) points out that at an air temperature of 27 degrees C an adult gives off 55.5 kcal/hr of sensible heat and 42.8 kcal/hr of latent heat, while at a temperature of 24 degrees C, the amount of sensible heat is 66.5 kcal/hr and the amount of latent heat is 32.7 kcal/hr. Total heat liberation of an adult man in a state of repose, according to the American data, is 80-100 kcal/hr, for a woman it is 15 percent less.

The amounts of sensible and latent heat liberated by a man as a function of ambient temperature can be determined according to a chart (figure 66).

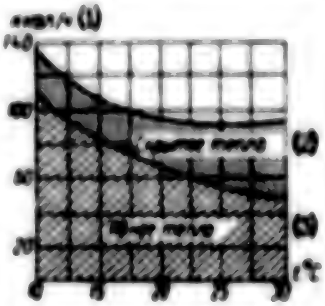


Figure 66. Heat Liberation of a Person in a State of Repose (Sitting).

Key:
1. Kcal/hr.
2. Latent heat.
3. Sensible heat.

[43] Al'pern, D. Ye. "Patologicheskaya fiziologiya" [Pathological Physiology]. Medgiz, 1959.

At the temperature interval 20-32 degrees C, the overall value for heat genesis changes insignificantly, and therefore a constant can be taken as the computed value. Considering the mixed makeup of the occupants of the shelters as to age and sex, 75 kcal/hr can be assumed for the estimated amount of heat liberation by a person in a shelter.

The amount of moisture liberated depends greatly upon the conditions for heat exchange of the body with the environment.

For practical computations, in determining the value of moisture liberation, the following formula can be used:

$$d = 7(t_{B} - 15), \tag{103}$$

where d is the heat liberation of a person, in grams/person-hour; and
t_{B} is the temperature of the surrounding air, in degrees C.

In shelters where the air's relative humidity is close to the maximum, the skin's sweat does not evaporate completely. Part of the sweat runs from the skin's surface without taking part in the overall heat exchange.

The amounts of oxygen consumed and of carbon diox liberated, depending upon a person's state, are marked by the following data: in a resting state and under normal meteorological conditions, a person lying down consumes 14.2 liters/hr of oxygen and gives off 11.8 liters/hr of carbon dioxide; during walking, the amount of oxygen absorbed is increased to 19.7 liters/hr, while less than 15.8 liters/hr of carbon dioxide are given off.

When people stay in a shelter's atmosphere, a rise in pulmonary ventilation is observed, and oxygen consumption grows to 20-24 liters/hr, while less than 20 liters/hr of carbon dioxide is liberated.

Change of the air's gaseous composition and the heat and moisture parameters in shelters occurs fairly intensely.

In unventilated shelters the decisive parameters that determine the condition of the shelter's occupants and the possible duration of their stay in the shelter are the gaseous parameters of the air, since they reach their maximum values much earlier than is the case with the heat and moisture parameters of the air.

Where the volume of a premise is 1.3-1.5 m^3 per person, carbon dioxide content grows to 3-4 percent in 2-2.5 hours. A longer stay of people in the unventilated shelter can lead to unpleasant unconsequences.

The time for increase in carbon dioxide concentrated to the maximum values is determined in accordance with the formula

$$t = \frac{C_{dop}V}{B \cdot 100}, \tag{104}$$

where C_{dop} is the maximum endurable concentration of carbon dioxide, in percent;
V is the volume of the premises per person, in liters; and
B is the amount of carbon dioxide released per person, in liters/hr.

In ventilated shelters the greatest difficulties are those of dealing with surplus heat and moisture. When outside air is supplied in the amount of 1.5-2 m^3/hr per person, the gas parameters are held within permissible limits. The carbon dioxide concentration does not exceed 1-1.5 percent.

However, this amount of air is, as a rule, insufficient for maintaining the temperature and moisture of the air within the permissible limits for a lengthy period.

A sharper rise in temperature is observed in the first hours of operation of a shelter. In 10-12 hours the air temperature in built-in brick-walled shelters at an air feed of 2 m^3/hr per person reaches 29-30 degrees C.

The amount of air feed necessary to deal with excess heat and moisture can be determined from the expression

$$L = \frac{q}{\gamma (J_B - J_H)} = \frac{W}{\gamma (d_B - d_H)}, \qquad (105)$$

where q and W are the amounts of heat and moisture liberated per person;
J_H and d_H are the heat-content and moisture-content of the outside air;
J_B and d_B are the heat content and moisture content of the air within the structure; and
γ is the bulk density of the air, equal to 1.2 kg/m^3.

The values J_B and d_B are chosen in accordance with the permissible parameters of shelter air. With elimination of the entire amount of heat and moisture (not counting the heat absorbed by the enclosing structure), equation (105) can be expressed in the form:

the equation of heat balance is

$$75 = 1.2L(J_B - J_H); \text{ and} \qquad (106)$$

the equation of moisture balance is

$$7(t_B - 15) = 1.2L(d_B - d_H), \qquad (107)$$

where 75 is the amount of heat liberated per person, in kcal/hr;

$7(t_B - 15)$ is the amount of moisture liberated per person in grams/hr; and

t_B is the air temperature in the shelter, in degrees.

The values J_B and d_B, which correspond to the maximum value of the effective temperature $T_{eff} = 27$ degrees ET, which has been adopted as acceptable for a lengthy stay in a shelter, can be expressed with a precision that is acceptable for practical computations in terms of t_B by means of the equations:

$$J_B = 43.4 - 0.82t_B; \text{ and} \tag{108}$$

$$d_B = 71 - 1.75t_B, \tag{109}$$

which, together with the equations of balance for heat and moisture, yield a system of four equations. In solving this system we get expressions for determining air feed per person sheltered

$$L = \frac{a + \sqrt{a^2 + 2100b}}{2bJ}, \tag{110}$$

where $a = 8.4J_H - 103.7$ and $b = 25.5 + 1.2d_H - 2.5J_H$.

The Soviet Union's territory can be divided, with reference to climatic conditions, into eight climate zones (figure 67).

The average values for air supply that are needed for maintaining permissible temperature and moisture parameters in a shelter are shown in table 27.

Table 27

Average Air-Supply Values for the USSR's Various Climate Zones

Climate zones (see figure 66 [sic])	I	II	III	IV	V	VI	VII	VIII
Calculated amount of air, m^3/person·hour	5	6	7	8	10	12	15	20

Air can be supplied in the amounts shown in table 27 at minimum expense only where there are no toxic substances or bacterial agents in the outside air, that is, where the shelter is operated in a pure ventilation mode, with preliminary removal from the air flow only of radioactive dust.

Purifying the air of toxic substances and bacterial agents would require the installation of a large number of expensive filters and additional space for installing them. Moreover, the high aerodynamic resistance of absorbent filters restricts the possibility of supplying large amounts of air during manual drive of the fan. The amount of air supplied under a ventilation-filter mode is determined, as a rule, on the basis of

maintaining an acceptable gas composition of the air, which is 2 m^3 per hour per person.

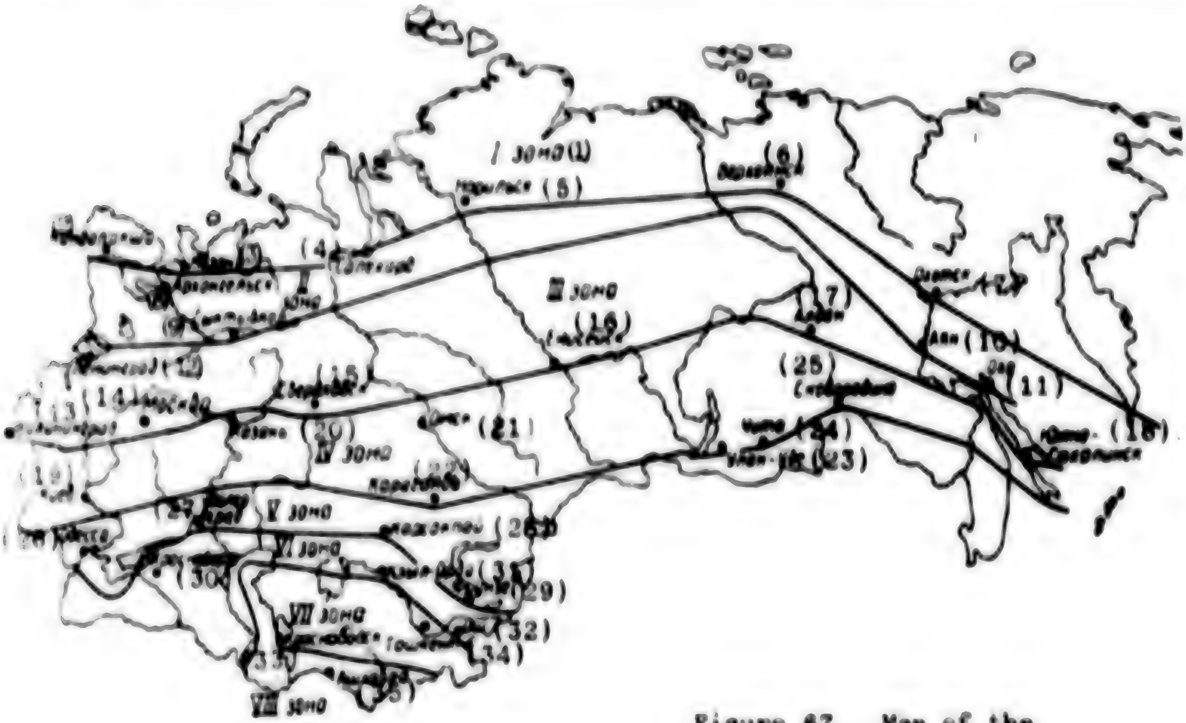


Figure 67. Map of the USSR's Climate Zones.

1. Zone 1.
2. Kandalaksha.
3. Mezen'.
4. Salekhard.
5. Noril'sk.
6. Verkhoyansk.
7. Okhotsk.
8. Arkhangel'sk.
9. Syktivkar.
10. Ayan.
11. Okha.
12. Leningrad.
13. Kaliningrad.
14. Moscow.
15. Sverdlovsk.
16. Yeniseysk.
17. Aldan.
18. Yuzhno-Sakhalinsk.
19. Kiev.
20. Kazan'.
21. Omsk.
22. Karaganda
23. Ulan-Ude.
24. Chita.
25. Skovorodino.
26. Odessa.
27. Volgograd.
28. Karsakpay.
29. Frunze.
30. Krasnodar.
31. Kzyl-Orda.
32. Osh.
33. Krasnovodsk.
34. Tashkent.
35. Ashkhabad.

The heat and moisture parameters of the air can be maintained within permissible limits when the supply of outside air is restricted under a mode of ventilation and filtration and regeneration of internal air during fires, the duration of which, apparently, will not exceed 10-12 hours, by the enclosure structure's accumulation of the heat.

Calculations indicate that permissible values of temperature and moisture of the air are maintained in a shelter for 10-12 hours where the enclosure-structure area norm per person is from 1.5-1.8 to 3-3.5 m^2, depending

upon the region in which the premises that are being adapted for shelter are located and the heat-physics properties of the enclosure structure.

The enclosure-structure area per person in a shelter where the minimum norm for accommodation (the floor area norm) is 0.5 m^2 per person and the premises height is 2.2 m is about 1.3-1.8 m^2. Thus, in individual cases an increase in floor area per person is required in order to maintain endurable conditions. The average floor-area norms that provide for maintenance of the air's heat and moisture parameters within permissible limits for 10-12 hours are shown in table 28.

Table 28

Floor Area That Provides for Maintenance of the Air's Parameters for 10-12 Hours

Type of enclosure structure	Floor area per person, in m^2, for climate zones: I-III	IV-V	VI-VIII
Made of stone or brick masonry or reinforced-concrete members...........	0.5	0.65-0.7	1
Made of monolithic reinforced concrete..	0.5	0.5-0.6	0.75

If, in adapting basement premises for shelter, an increase in the accommodation norms does not involve capital costs, it is possible to dispense completely with use of the pure ventilation regime in dealing with an excess of heat and moisture.

Studies were conducted in the USA on the possibility of removing excess heat from a shelter through the enclosure structure (walls, floor and ceiling) alone. The computations established that, given an average soil temperature of 7.2-14.7 degrees C, the air temperature in the shelter for 2 weeks will not exceed the maximum permissible level, provided that there are 4.5 to 9.29 m^2 of enclosure-structure area per person [44].

The norms for the area of enclosure surfaces that will support maintenance of the air medium's parameters for 2-3 days when the outside air supply is restricted (2 m^3 per person per hour) are given in table 29.

Table 29

Area of Enclosure Structure That Will Provide for Maintenance of Air Parameters for 2-3 Days

Type of enclosure structure	Enclosure-structure area necessary to absorb excess heat for 2-3 days, m^2 per person, for climate zones: I-III	IV-V	VI-VIII
Made of stone or brick masonry or reinforced-concrete members........	2.5	3.25	4.5
Made of monolithic reinforced concrete	1.5-1.8	2.2	3.25

[44] Jagloy, C. P. "Limits for Cold, Heat and Humidity in Underground Shelters." ARCHIVES OF ENVIRONMENT OF HEALTH, No 2, 1961, pp 110-115.

The use in shelters of special installations for cooling and drying air requires great expense and is possible only in structures that have protected emergency sources of electricity and water supply.

Based on economic considerations, the use of an air-conditioning installation is more desirable in large-volume structures that are situated in a hot-climate belt where soil temperatures are high.

Sources of cold for cooling air can be artesian water or freon cooling installations.

Local or central nonautonomous air conditioners and special dry air-coolers or heaters can be used as heat-exchange apparatus.

When analyzing and choosing air-cooling equipment, the heat liberated by power equipment and the change in the heat and moisture content of the regenerated air also must be considered, along with the heat that people liberate.

3. The Air Supply of Shelters

The necessity for equipment for shelter ventilation systems and for installations for the removal of radioactive dust, toxic substances and bacteria from outside air, and for devices for protecting air intake and exhaust conduits from shock-wave effects, stems from the requirements that are made for sanitary and hygienic conditions in shelters when thermonuclear and other types of mass destruction weapons are used.

The temperature and gaseous content of atmosphere air is changed sharply with the spread of large-scale fires in the city. New, secondary health hazards appear, the main ones being carbon monoxide and heat. Carbon monoxide is very toxic. Its harmful effect on the human body is caused by the displacement of the oxygen of the blood's oxyhemoglobin by carbon monoxide and the formation of carboxyhemoglobin.

Numerous observations indicate that at a carbon monoxide concentration of 0.45 mg/liter, headaches and nausea appear in 1-2 hours, and, with a concentration of 0.9 mg/liter, a person loses consciousness in 2 hours, and death arrives in 2 hours with a concentration of 1.8 mg/liter, or in 30 minutes at 3.6 mg/liter [45].

Table 30 shows the proposed parameters of atmosphere air during fires in category 1, 2 and 3 fire-hazard districts during the combustion of the destroyed parts of buildings (where there are fires in the debris).

The data on the chemical content of atmosphere air shown in table 30 indicate fairly convincingly that shelters can be supplied with air from the

[45] Flyuri, F. and Tsernik, F. "Brednyye gazy" [Harmful Gases]. GONTI, 1938.

Table 30

Outside Air Parameters During Large-Scale Fires

Fire-hazard category of the district	Maximum tempera- ture of influx air, in °C	Probable maximum concentration, %			Duration of fire, in hr
		CO	CO_2	O_2	
1	800	5.4	16	6	5
2	500	0.2	0.7	18	6-8
3	200	-	-	21	6-8
Fires in debris	230	0.4	3	17	10-12

outside during fires only where the shelters are located in category 3 fire-hazard districts, where the gaseous content changes within acceptable limits.

The low percent of oxygen content and the increased carbon dioxide content in atmosphere air during fires in category 1 and 2 fire-hazard districts, and also when debris is on fire, do not permit its use for air supply even when the shelter has means for cooling and purifying the influx air of carbon dioxide. It becomes necessary to convert the shelter to a mode of full isolation, with the regeneration of inside air. However, during fires, when converting shelters to a full isolation mode, the danger appears of outside air penetrating through leakiness of the enclosing structure from the effects of heat and wind stress.

In order to prevent the entry of outside air because of leakiness of the enclosing structure, an excess of pressure (a head) of air equal to 1.5-2 mm H_2O must be maintained in the shelter. The head of air can be maintained by the organized feed of outside air in the shelter with preliminary removal therefrom of carbon monoxide and with cooling thereof, or by release in the shelter of compressed air from high-pressure tanks.

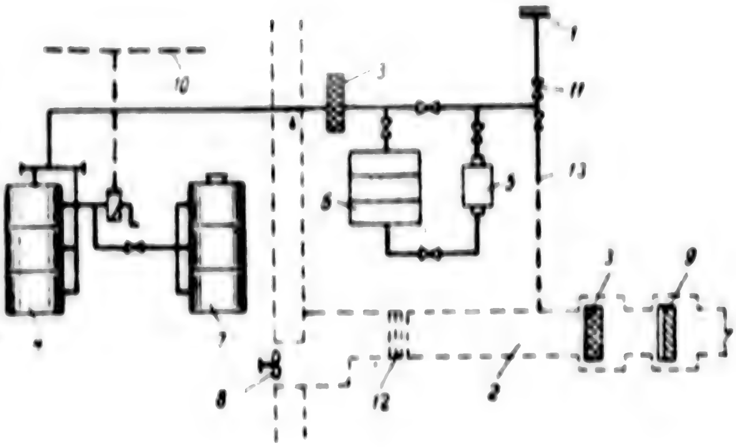
The minimal amount of air (in m^3/hr) necessary for maintaining a head of 1.5-2 mm H_2O, where the degree of seal of the basement is characterized by a head of air of 10 mm H_2O during a one-time exchange of air, is reached by feeding into the shelter an amount of air equal to one-third the volume of the premises in 1 hour.

Thus, in shelters situated in category 1 and 2 fire-hazard districts, the introduction of a special air-supply mode is required that calls for the use of regeneration equipment for maintaining the gaseous content of the air within acceptable limits and the feed of a minimal volume of outside air in order to maintain the head.

In order to provide for the collective protection of the occupants of shelters located in category 1 and 2 fire-hazard districts, the air supply schemes shown in figures 68 and 69 can be recommended.

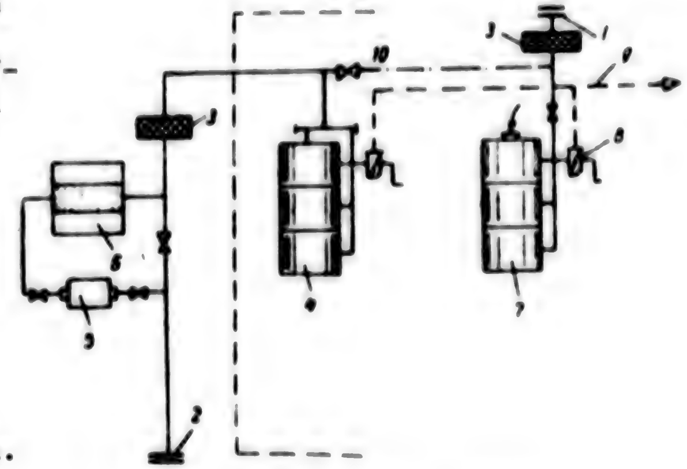
The diagrams include equipment that provide for:

Figure 68. Schematic Diagram of Air Supply, Using an Axial-Flow Fan to Feed Air in a Pure Ventilation Mode.



Key:
1. Air intake conduit of the ventilation-filtration mode.
2. Air intake conduit combined with manhole-passageway.
3. Dust filter.
4. FVA-49 ventilation-filtration unit.
5. Carbon monoxide filter.
6. Heat-absorbing filter.
7. Regeneration installation.
8. Axial-flow fan.
9. Antiexplosion unit.
10. Distribution system.
11. Sealing valves.
12. Protective sealing shutter.
13. Connecting pipeline.

Figure 69. Schematic Diagram of Air Supply with Installation of an Additional Centrifugal Fan for Feeding Air in a Mode of Pure Ventilation and Regeneration of Inside Air.



Key:
1, 2. Air intake conduits.
3. Dust filter.
4. FVA-49 ventilation-filtration unit.
5. Carbon monoxide filter.
6. Heat-absorbing filter.
7. Regeneration installation.
8. ERV-49 centrifugal fan.
9. Distribution system.
10. Connecting pipeline.

a) Feed of outside air under a pure ventilation mode;

b) Feed and purification of outside air under a ventilation-filtration mode.

v) Regeneration of inside air and one-time feed of outside air with preliminary removal of carbon dioxide therefrom and cooling thereof during fires.

When siting a protective structure within fire-hazard zones, outside air cannot be fed for maintenance of the head during fires except where there

to an increased degree of sealing of shelters to 50–60 mm H_2O. The indicated degree of tightness is achieved in shelters that are made out of reinforced concrete and where the general-construction work has been done with good quality.

In shelters located in fire-safe zones or in category 3 fire-hazard districts, schemes for ventilation are significantly simplified. Thus, it is not required that equipment to regenerate air and to remove carbon monoxide from influx air be used in category 3 fire-hazard districts, or that equipment for cooling influx air be used in fire-safe zones.

All the air supply schemes for feeding outside air under the pure ventilation and ventilation-filtration modes call for the installation of separate air intake conduits. The distance between the air intake conduits has not been standardized. The air intake conduits should be equipped with antiexplosion devices and be ended at the ground surface by reinforced-concrete pipes at least 1.5 meters tall. The air intake ducts should be placed on ground that is unobstructed.

It is desirable to use the emergency manhole-passage as a conduit for the air intake under the pure ventilation mode (see figure 68). Air intake conduits can be made out of steel or reinforced-concrete pipe and reinforced-concrete manholes laid in the ground at a depth of at least 1 meter. As an exception, the construction of one of the air intake conduits directly in the mass of the enclosure structure can be allowed. It is necessary also to specify that the air intake conduits be joined with each other in case one of them becomes inoperative. A sealing valve should be installed on the connecting pipeline.

The cross-section of the air intake conduits should be chosen in such a way that their aerodynamic resistance does not exceed 3 mm H_2O (not counting the resistance of the antiexplosion unit).

In order to feed influx air and to remove toxic substances therefrom by these schemes, the use of the standard FVA-49 ventilation-filtration unit is advisable. The ventilation-filtration unit includes (figure 70): the ERV-49 electrical and manual fan 1; an absorbent filter 2, double-sealing valve 3, air meter 4, and connecting and shaping parts 5 [46].

Productivity of the unit when operating through the filter is 280–300 m^3/hr, while over the bypass line it is 400–450 m^3/hr.

The head that is developed by the electrical and manual fans with a rated productivity of 300 m^3/hr is 85 mm H_2O. Power consumed by the electric motor is 0.28–0.3 kw. A general view of the ERV-49 fan and its aerodynamic characteristics are shown in figures 71 and 72. The presence of a manual drive on the fan enables air to be fed in the shelter when there is no electricity.

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[46] "Instruktsiya po montazhu i ekspluatatsii fil'troventilyatsionnykh agregatov FVA-49" [Instructions for the Installation and Operation of FVA-49 Ventilation-Infiltration Unit]. Voyenizdat, 1957.

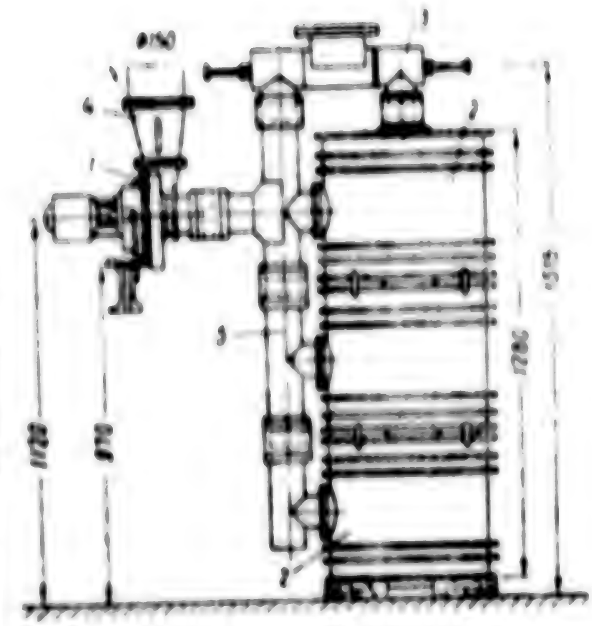


Figure 70. FVA-[illegible] Ventilation-Filtration Unit.

Key:
1. Electrical and manual fan.
2. Absorbent filters.
3. Hermetic-sealing valve.
4. Flowmeter.
5. Connecting parts.

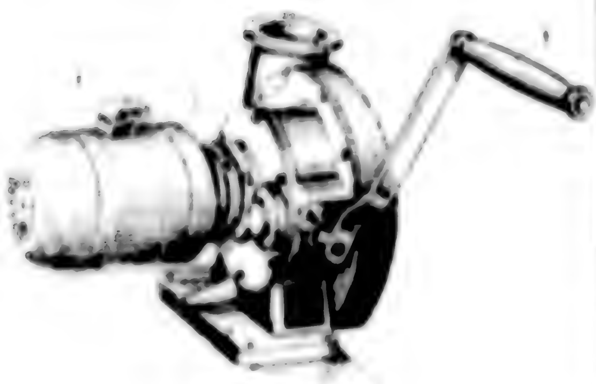


Figure 71. ERV-49 Electrical and Manual Fan.

Key:
1. Fan.
2. Reduction gear.
3. Electric motor.
4. Terminal box.
5. Handle.
6. Mounting plate.

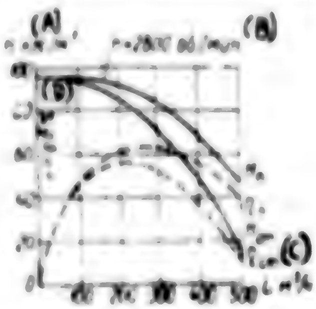


Figure 72. Aerodynamic Characteristics of the ERV-49 Electrical and Manual Fan.

Key:

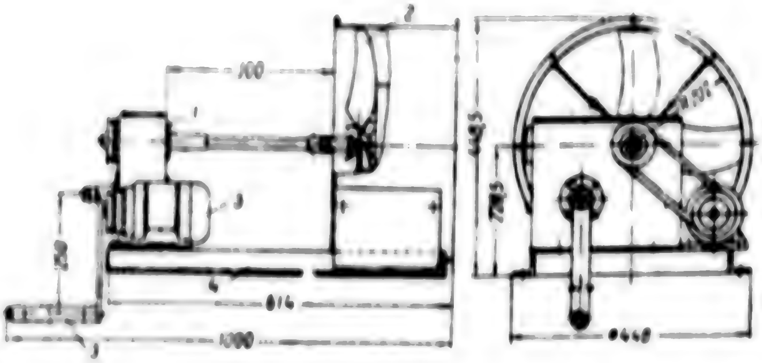
H_n.	Full head.	A.	H, kg-force/m^2.
η_n.	Full output.	B.	n = 2,800 rpm.
H_{st}.	Static head.	C.	L, m^3/hr.
η_{st}.	Static output.	D.	Output in percent.

When the air supply system operates under the ventilation-filtration mode, outside air enters along the air intake conduit 1 (see figure 68) through the dust filter 2 to the ventilation-filtration unit 4, passes through the absorbent filter and is fed into the shelter's sections along the distribution system 10. When there is fire, the outside air, prior to entering the ventilation-filtration unit, passes through filter 5, which removes carbon monoxide from it, and heat-absorbent filter 6.

Feeding of outside air under the pure ventilation regime in the amount necessary for dealing with excessive heat and moisture, which is shown in figure 69, is performed by an axial-flow fan with manual drive 8. An external view of the axial-flow fan with manual drive and its aerodynamic characteristics are shown in figures 73 and 74.

Figure 73. Axial-Flow Fan with Manual Drive.

Key:
1. Reduction gear.
2. Vane.
3. Handle.
4. Stand.
5. Electric motor.



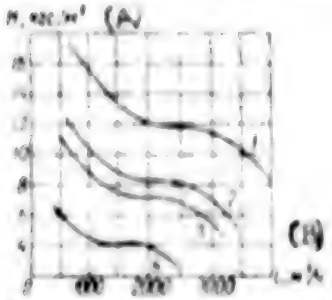


Figure 74. Aerodynamic Characteristics of Axial-Flow Fan (rpm's of the Reduction-Gear Handle (and of the Vane)).

Key:

1. 50 (1,800).	4. 30 (1,080).
2. 42 (150).	A. H, kg-force, m^2.
3. 40 (1,400).	B. L, m^3/hr.

The installation of a second ERV-49 electrical and manual fan was called for in figure 64 for this same purpose. Under the pure ventilation mode, two electrical and manual fans provide for a feed of about 900 m^3/hr of air.

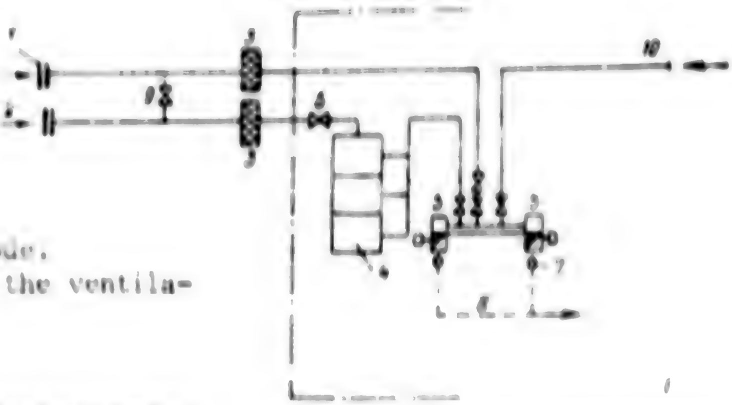
The constructional features of the axial-flow ventilator does not enable a distribution network to be joined to it, so it can be used where there are exhaust openings and openings in the partitions of the shelter's compartments that enable uniform distribution of air about the premises. Total aerodynamic resistance of the ventilation system during use of the axial-flow fan, including the resistance of the antiexplosion unit and the dust filters, should not exceed 12-15 mm H_2O.

In shelters of large capacity, where there is an emergency power supply for air feed, TsD, EVR, VRS and other types of centrifugal fans that are widely used in the national economy can be used with all operating modes. A schematic diagram of air supply with the use of general-purpose fans is shown in figure 75.

In order to clean influx air of toxic substances and bacteria, FP-100yu, FP-100-59 and FP-200-59 absorbent filters can be used in the filtration systems.

The absorbent filter (76) is a drum with two central (end) openings and one side opening. The outside air enters the filter through one of the central openings, where it is cleaned of toxic substances, and leaves through the side opening. The clearance dimensions and specifications of the absorbent filter are shown in table 31.

Figure 75. Schematic Diagram of Air Supply for Shelters Located in Fire-Free Districts, Where There is a Protected Source of Electric Power.



Key:
1. Air intake conduit for the pure ventilation mode.
2. Air intake conduit for the ventilation-filtration mode.
3. Dust filter.
4. Absorbent filter.
5. Centrifugal fan with electric motor.
6. Sealing valve.
7. Gate valve.
8. Distribution system.
9. Connecting pipeline.
10. Recirculation pipeline.

Figure 76. Absorbent Filter.

Key:
1. Opening for entry of air.
2. Opening for exit of air. 3. Air.

Table 31

Characteristics of FP-100 Absorbent Filter

Productivity, m^3/hr	Aerodynamic resistance, H_2O	Clearance dimensions, in mm		
		Diameter	Height	Entry opening diameter
100	50	550	437	100

Absorbent filters of all types can be installed in columns of 2-3 units each. More than three filters should not be mounted in one column, since in so doing the resistance of the filter collectors is increased considerably. In mounting absorbent filters in columns, standard shaping pieces that are connected to each other by rubber couplings and tightening collars are used. If large amounts of air must be fed, columns of absorbent filters are joined in a battery.

Dust filters that are part of an air supply system are intended to clean the air of the radioactive dust that contaminates the near-surface layer of the atmosphere when dust falls from the radioactive cloud and during secondary dust formation.

When outside air is fed under a ventilation-filtration mode, dust filters serve as the first stage in removing dust from the air. Absorbent filters provide for finer cleaning. Under the pure ventilation mode, dust filters are the only means of cleaning influx air.

in the dispersed state, radioactive dust can be assigned to groups 3 and 4, that is, dust with particle sizes of more than 10 microns. Such dust is captured fairly well by most filters that are used in the national economy.

The fraction-by-fraction coefficient of cleaning the air of dust, which characterizes the ratio of the amount of retained dust to the total amount of dust that enters the filter, should be no less than 95 percent:

$$\eta = \frac{C_н - C_к}{C_н} 100 = 95\%, \tag{111}$$

where η is the dust-cleaning coefficient; and

$C_Н$ and $C_К$ are the initial and final dust concentrations.

Dust filters that are used in shelters should tolerate long-term storage and should withstand a shock-wave pressure of up to 0.2 kg-force/cm^2 behind the antiexplosion unit.

The filtration area of filter surfaces should be determined by taking into account their aerodynamic resistance and dust content, which should be no more than 500 grams at an air feed of 1,000 m^3/hr.

In considering that every increase in resistance of the ventilation network impedes the feed of outside air, the aerodynamic resistance of the dust filters should not exceed 8-10 mm H_2O when feeding air under either the pure ventilation mode or under the ventilation-filtration mode.

Engineer Ye. V. Rekk's honeycomb oil-filter system, which answers more completely the requirements named, can be recommended for use in shelters. The honeycomb of this filter (figure 77) consists of a mounting frame and metal compartments into which are laid crimped metal grids that are wetted by petrolatum or by spindle oil (No 2 or No 3) [46]. Two models of the filters are being produced: large B and small M (table 32).

Table 32

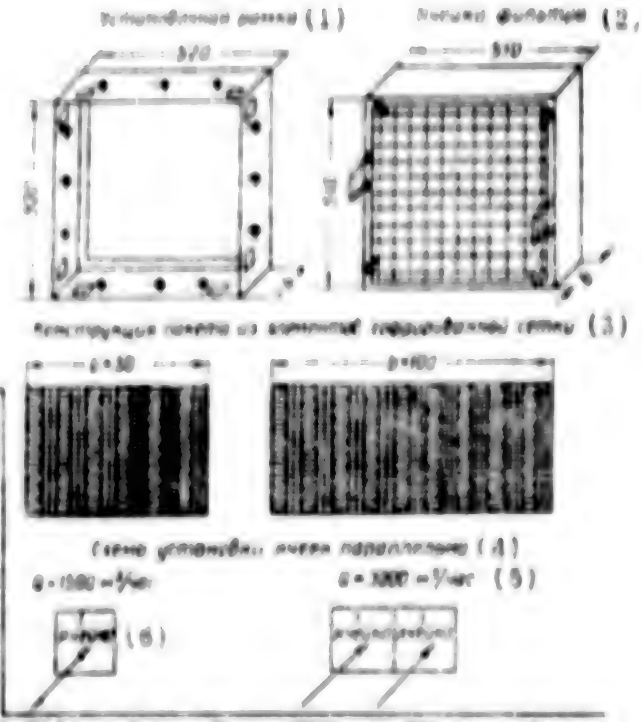
Characteristics of Engineer Ye. V. Rekk's Honeycomb Oil-Filter System

Indicators	Model B	Model M
Productivity, m^3/hr.	1,500	1,500
Aerodynamic resistance, mm H_2O	12	8
Coefficient of dust removal where the fractional composition of the dust is more than 10 microns, %	97	97
Dust content, grams	800	500
Number of grids	18	12
Clearance dimensions, mm	520x520x100	520x520x50

[46] "Instruktsiya po montazhu i ekspluatatsii fil'troventilyatsionnykh agregatov FVA-49" [Instructions on the Installation and Operation of FVA-49 Ventilation-Filtration Units]. Voyenizdat, 1957.

Figure 77. Dust filter of Engineer Rekk's system.

Key:
1. Mounting frame.
2. Honeycomb of the filter.
3. Design of a packet of elements of the crimped network.
4. Scheme for installing the honeycombs in parallel.
5. V = 1,500 m^3/hr.
6. One honeycomb.



The filter's honeycomb is easily cleaned of dust by washing it with a hot 5-percent soda solution.

In addition to the filter of engineer Ye. V. Rekk's design, honeycomb filters with Raschig rings, made of synthetic fiber, and filter bags from FVK or FV type bag suction filters can be used when adapting basements as shelters.

The bags of the filters can be made of unbleached calico or unbleached flannel or of vicuna or blended wool. It is well to place bag filters in the manhole passage when it is used as an air intake conduit.

The deficiencies of cloth filters are: slow filtration speed, restrictedness of use at high temperatures, and hygroscopicity.

When the shelter has an emergency source of electric power for cleaning the air of dust, KD-10 and KD-20 type self-cleaning oil filters with electric-motor drive for the filtering shutters can be adapted.

In order to cool influx air during fires, filters made of gravel and other heat-absorbing materials can be used. The gravel is placed in a special chamber with brick or reinforced-concrete walls on a metal grating. The amount of gravel should be adopted on the basis of 2 m^3 per 300 m^3/hr of feed air when shelters are located in category 3 fire-hazard districts, and per 100 m^3/hr in category 1 and 2 fire-hazard districts. A filter-layer thickness of 0.8-1 meter has been adopted.

The simplest and most widespread method for purifying air of carbon monoxide is to burn it into carbon dioxide by means of Hopcalite, the main component of which is active dioxide of manganese.

FPT or FPCh filters, which are loaded with Hopcalite FK-u type cassettes and are produced by industry, can particularly be recommended as filters to remove carbon monoxide from the air.

combustion of carbon monoxide occurs more effectively at high temperatures, so, in air supply schemes, the carbon monoxide filter is installed ahead of the semi-absorbent filter, which simultaneously prevents poisoning of the hopcalite by the moisture that precipitates when the air is cooled.

Among the means for regenerating air in shelters, regenerating cartridges and regenerating installations of the convection type (RUKT), which provide for maintenance of the air's chemical content within acceptable limits, can find use.

The regenerative cartridge is similar externally to the FP-100 absorbent filter. Air in the regenerative cartridge fails through the central or side opening and carbon dioxide is removed by means of various chemical calibrated absorbers that are inside the body. Abroad, a composition of 20 percent NaOH and 80 percent $Ca(OH)_2$, soda lime and lithium hydroxide LiOH, is used widely for charging regenerating cartridges. The reaction of carbon dioxide absorption by chemical absorbers is accompanied by the liberation of heat. One kilogram of the indicated absorber sorbs about 100-300 liters of carbon dioxide and liberates, in so doing, 120-850 kcal of heat.

Regenerating cartridges, just like absorbent filters, are mounted in columns. Air intake for regeneration can be performed in centralized fashion, directly from the ventilation-filtration chamber. A network of air-distribution conduits is used to feed the regenerated air into the shelter compartments. Sealing valves are installed on the feeder air lines that connect the regenerating cartridges with the distribution grid.

During use of the regenerating cartridges, the oxygen deficit is made up from oxygen stored in tanks. Seamless tanks made of carbon or alloyed steel are used to store the oxygen. The use in shelters of medium-capacity tanks, the clearance sizes of which are shown in table 33, can be recommended for transport conditions and convenience in placement and operation.

Oxygen is fed into the ventilation network through a reducer. During the simultaneous feed of oxygen from several tanks, these are joined by a common pipeline (ramp). Reserve tanks can be stored in the ventilation and filtering chamber or in a special premise.

The large leak of oxygen from the tanks through the valve requires periodic replacement of tanks. This reduces considerably the reliability of this method of regeneration.

Regenerating installations of the convection type, which are based on the use of superoxide compounds of sodium or potassium, are a more improved means for regenerating the air. They provide for the simultaneous absorption of carbon dioxide gas and the liberation of oxygen.

Air is drawn through convection-type regenerating installations under the influence of a thermal head (convection currents); use of an artificial draft is not required.

Table 33*

Oxygen-Tank Characteristics

Capacity of the tanks, liters	Seamless steel tanks for gases, per GOST 949-57				
	Type of tank (nominal pressure, in kg-force/cm²)	Tank sizes, in mm			Weight, in kg
		Outside diameter	Wall thickness	Body length	
20	150	219	7	770	34
25	150	219	7	[illegible]	40.5
[illegible]	200	219	9.3	976	[illegible]
30	150	219	7	1,0[illegible]	[illegible]
[illegible]	200	219	9.3	1,1[illegible]	[illegible]
40	150	219	7	[illegible]	[illegible]
40	200	219	9.3	1,390	[illegible]
[illegible]	150	219	7	1,500	[illegible]
[illegible]	200	219	9.3	1,7[illegible]	[illegible]

*According to Price List 23-02, 1969

A regenerating installation of the convection type (Figure 78) is a metal body rectangular in shape. In the lower part of the body are openings for entry of the air to be regenerated. On top the body is [illegible] with side openings for the exit of air. Special cassettes are inserted into the body. Prior to charging, the cassettes are stored in a sealed packing.

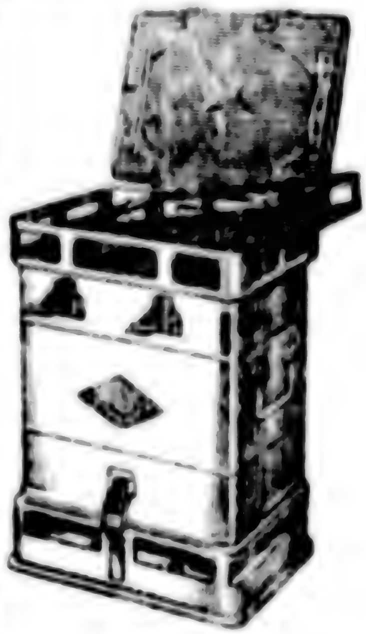


Figure 78. Convection-Type Regenerating Installation.

Industry is producing RDU type regenerative installations in which the cassettes are installed in two rows.

Convection-type regeneration installations in small-capacity shelters should be placed directly in the premises intended for the occupants. It is forbidden to use an open flame close to regenerative installations. The number of installations is determined by computation as a function of the time of regeneration, the number of persons sheltered, and the capacity of the installations as indicated in the technical description.

Regeneration installations with forced draft that are based on superoxide compounds of potassium and sodium peroxide have been developed and are being used abroad. In this case, 1 kg of potassium superoxide liberates up to 250 liters of oxygen and absorbs 150 liters of carbon dioxide. Such a solution allows monitoring over expenditure of the means for regeneration and reduces the area necessary for siting regenerative installations.

Sealing valves are designed for hermetic covering of air ducts when shifting operating modes of the ventilation-filtration system and also when individual elements or sections of it must be switched off.

The Mysheg Fixtures Plant is producing sealing valves 150, 200 and 300 mm or more in diameter with manual and electromanual drive. The valve 150 mm in diameter is being produced only with manual drive.

Valves with manual drive should be used when adapting basements as shelters.

Valves with electromanual drive can be used only in shelters that have an emergency source of electric power. The power of the electric motors for valves 200-600 mm in diameter is 0.18 kw.

Air ducts of the distribution grid are fabricated from steel sheet of round or rectangular cross-section. Ducts made of slag cement and asbestos cement can also be devised. The speed of movement of the air along the distribution pipelines should be no more than 5 m/sec.

When laying out influx and exhaust openings, special attention must be paid to uniform distribution of the air about the shelter's compartments.

In order to regulate air feed to various premises of the shelter, the installation of throttle valves and slides at influx openings on air ducts should be specified.

Spent air should be removed from the duct through exhaust openings and conduits by means of the head of air created by the forced ventilation system.

In shelters that have an autonomous source of electricity, it is desirable, in order to remove air, to install exhaust systems with forced draft. Exhaust conduits (and openings) should be placed in sanitary facilities, antechambers and other auxiliary premises.

The exhaust conduits are equipped with gate valves or excess-pressure valves (figure 79 and table 34).

Table 34

Clearance Dimensions of Excess-Pressure Valves (see Figure 79)

Type of valve	d_0	d_1	d_2	d_3	b	Number of openings
KID-100......	72	95	160	130	13	4
KID-150......	92	142	230	200	99	8

The productivity of excess-pressure valves, where the head of air is 5 mm H_2O, is

for the KID-100...... 65 m^3/hr
for the KID-150...... 130 m^3/hr

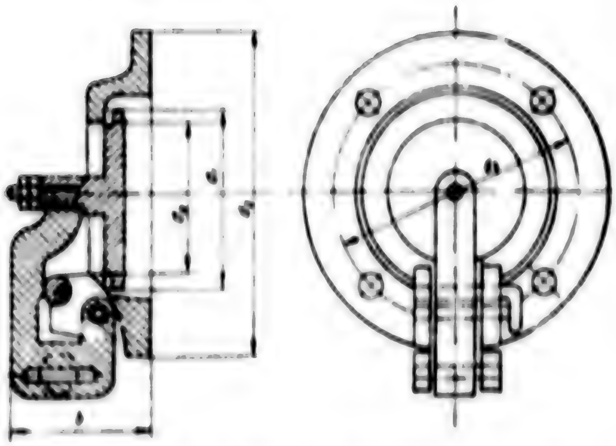


Figure 79. Excess Pressure Valve

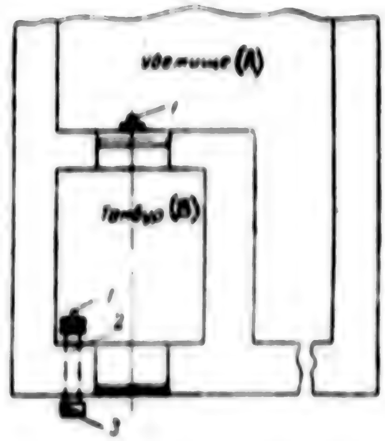


Figure 80. Scheme for Ventilation of the antechamber.

Key:
1. Excess-pressure valve.
2. Pipe that joins the antechamber with the earth's surface.
3. Antiexplosion device.

A. Shelter.
B. Antechamber

For ventilation of the antechamber, an excess-pressure valve should be installed in the door that connects the air lock with the shelter's main premises and on the pipe (on the antechamber side) that joins the antechamber with atmosphere air. Where a pressure of more than 1 kg-force/cm^2 on the pipe from the outer side is estimated, an antiexplosion device is installed (figure 80).

The main elements of the air supply system (the ventilation-filtration unit, fans, absorbent filters and air regeneration equipment) are installed in a separate premise--the ventilation-filtration chamber (FVK). The place for installation of the dust filter, which is the first stage for removing radioactive particles from the air, should be separated from the main shelter premises by a permanent type wall or by a layer of soil 90 cm thick, since later, under certain conditions, it will become a source of strong radioactive contamination.

Ventilation system operating modes should be chosen as a function of the surface situation.

After the shelter is filled and the protective and hermetically protected doors and shutters (manholes) are closed, the ventilation-filtration mode should be introduced in the shelter. Under this mode all the sealing valves that are installed on the bypass line of the absorbent filter are tightly closed and the air ducts for the pure ventilation mode are covered. If in 1 hour no nuclear explosion or chemical or bacteriological attack has occurred, the shelter can be converted to the pure ventilation mode. Ventilation installations that provide for outside-air feed in the amount necessary for the removal of excess heat and moisture are switched on.

when there is a nuclear explosion, the ventilation system should be turned off and all openings and air ducts that link up with the outside air should be sealed, in order to prevent choking of the filtering devices with dust. In 30-40 minutes after the explosion, when the main mass of the dust has settled, the ventilation and filtration system can be turned on.

If fires break out, shelters equipped with protection against combustion products can also turn on the regeneration installation and the Hopcalite and heat-absorbing filters when necessary.

The regenerating installations and Hopcalite filters should be switched on when carbon monoxide in the intake air is observed, and the heat-absorbing filters should be switched on when the influx air temperature rises to 28 degrees C.

Probes for analysis of the air are withdrawn directly at the intake openings.

Feed of influx air during operation of the regeneration equipment should be cut to the minimum value necessary for maintaining the air head.

A repeat introduction of the pure ventilation mode, with the removal of dust only by the dust filter, is possible at a datum level of radioactive contamination of up to 3,000 r/hr after the fire ends.

If there are no dust filters in the ventilation system, conversion to the pure ventilation regime will be possible only where there is a drop in radioactive contamination to 80 r.

In case it is necessary to introduce the pure ventilation regime at higher radiation levels (with a sharp worsening of heat and moisture parameters of the shelter's air) shelter occupants should temporarily use individual means of protection (masks or gas masks).

Shelter operation should be converted from one mode to another by commands that arrive from the command post. In the absence of communications with the command post, it is necessary, in determining the possibility of switching regimes, to take measurements of the level of radioactive contamination of the area in the vicinity of the shelter and determine the presence of toxic substances and bacterial agents in the outside air.

In addition to the enumerated analyses, it is necessary, during shelter operation, to regularly monitor: the shelter's head of air, the amounts of air being fed from outside and of regenerated air, the temperature and relative moisture, the carbon dioxide concentration, the expenditure of regeneration resources, and so on.

In order to make these analyses, the shelter must be provided with sets of monitoring and measuring instruments.

In order to determine the air head in shelters, the TNZh liquid draft and heat gage with a scale from 0 to 25 mm H_2O or an ordinary tilting micromanometer can be used.

A head gage is installed in the ventilation-filtration chamber. For change of the air head in the shelter, the head gage is connected by a rubber hose with a tube that is in contact with the outside air.

The consumption of outside and regenerated air can be determined with a R-49 flowmeter, which is supplied as part of the ventilation-filtration unit, or it is measured by an anemometer. In large-capacity shelters, when industrial centrifugal fans are used for air feed, the amount of air being fed is determined by the draft-and-head gage and by a measuring diaphragm that is mounted in the air duct. In this case, the draft-and-head gage operates as a differential manometer.

The air temperature in the shelter compartments is monitored by room thermometers that have been hung on inner partitions in each compartment at a height of 1.5 meters from the floor.

In order to measure the relative humidity, an MVK capillary hydrometer or domestic Avgust psychrometer can be used.

A concentration of carbon dioxide can be identified by a ShI-3 portable gas alarm or by a PGADU, which is used in coal mines.

Table 35

Monitoring and Measuring Instruments Necessary for Normal Shelter Operation

Instrument designations	Unit of determination	Number required
Thermometer, room type................	each	1 for each compartment
Psychrometer, Avgust, or MVK type hydrometer..........................	each	1 for each compartment
Manometer, tilted (or plenum gage)....	each	1 for each FVK
Flowmeter or measuring diaphragm......	each	1 for each FVK
Anemometer..........................	each	1
PKhR chemical reconnaissance instrument with set of indicator tubes....	set	1
Indicator, radioactivity, DP-63.......	each	1
Gas alarm for carbon dioxide..........	each	1

The presence of toxic substances and of carbon monoxide in the outside air can be determined by means of the PKhR-54 chemical reconnaissance instrument with indicator tubes for toxic substances and carbon monoxide, while for detecting radioactive contamination of the air in the shelter it is necessary to have a DP-63 radioactivity indicator.

The recommended list of monitoring and measuring instruments necessary for normal operation of a shelter is shown in table 35.

In large-capacity shelters it is desirable to have, in addition to the instruments indicated in table 35, an automatic alarm for toxic substances, an automatic instrument for observing bacterial agents, and a ventilation-filtration alarm for detecting radioactive contamination of the air.

4. The Protection of Air Intake and Exhaust Openings from the Effects of Nuclear Explosion Shock Waves

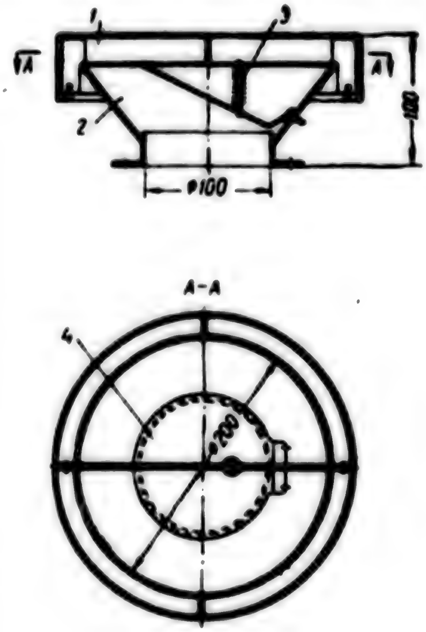
As has already been said, air intake and air exhaust lines should be equipped with special antiexplosion devices. They should provide for protection of the ventilation-filtration equipment and, simultaneously, prevent a rise in pressure in the shelter above that permissible through the influx of the shock wave of great duration that is formed during a nuclear explosion.

Various devices of industrial manufacture that operate directly from the effect of shock-wave pressure through the shifting of lightweight movable elements that cover up openings in conduits can be used as antiexplosion devices in shelters that are equipped with industrially manufactured equipment.

The air lines through which air from the shelter's lavatory and air locks overflow can be protected by a metal deflector with a clack valve (figure 81).

Figure 81. Metal Deflector.

Key:
1. Cover.
2. Body.
3. Spring.
4. Clack valve.



In shelters that are equipped with resources made from materials at hand, it is desirable to use the simplest antiexplosion devices.

A simplified protective unit with a wooden frame (figure 82) can be used in air intake conduits of the pure ventilation regime, while for the protection of the air ducts through which air overflows from the shelter, it is desirable to use a wooden deflector with a clack valve (figure 83).

The simplified protective unit consists of a wooden frame, metal ribs, a grate made of strip steel and metal spring-loaded vanes (the moving elements), which are attached to

the frame. The vanes are held in an open position at a 45-degree angle to the plane of the grate by a detainer, which restricts their opening.

Figure 82. Simplified Protective Unit.

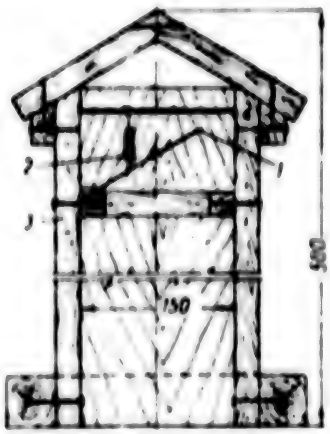


Figure 83. Wooden Deflector.

Key:
1. Clack valve.
2. Spring.
3. Duct.

The effect of the shock wave turns the vanes that cover the openings in the grate, and, as a result, penetration of the shock wave along the air intake (or exhaust) conduits in the shelter is terminated. Since the vanes operate rapidly, a short shock wave with substantially reduced pressure and operating time slips past the unit into the air duct.

The operating principle of the protective deflectors during the shock wave action is the same as that of the unit with the wooden frame.

In the protective deflector, the metal clack valve, which is made of steel sheet, is opened and held in the open position by a spring.

Metal vanes which are opened when the installation of the frame is in the vertical position under the influence of its own weight, can be used in the simplified protective unit (see figure 82).

When this unit is used in the exhaust conduit, it is installed in such a way that the vanes cover the openings in the grillwork under the influence of their own weight. In this case, the vanes will be opened by the head of air during ventilation system operation.

The aerodynamic resistance of the wooden deflector (see figure 83) for a 15x15 cm conduit with an air consumption of 100 m^3/hr is 4 mm H_2O.

The metal deflector (see figure 81) for a duct 100 mm in diameter has an aerodynamic resistance of 3 mm H_2O when air consumption is 75 m^3/hr.

The unit with the wooden frame (see figure 79), where the size of the grid for passing air is [illegible] mm and the air consumption is 3,000 m^3/hr, has an aerodynamic resistance of 4.5 mm H_2O. The frame of this section is made from beams [illegible] cm, the vanes from steel sheet 1 mm thick.

The [illegible] should be chosen on the basis of the [illegible] aerodynamic resistance.

The antiexplosion devices should be installed in immediate proximity to the air intake openings, at a distance of at least 3 m from the dust filter, if possible.

During installation, special attention should be paid to the strength and reliability of fastening. Antiexplosion devices made industrially are attached to [illegible] by bolts, but the simplified protective unit is fastened [illegible] splices made of wire.

When the [illegible] is installed in the manhole-passage, there must be [illegible] rapid disassembly or opening thereof in order to allow the [illegible] during evacuation.

[illegible] Power Supply of Shelters

[illegible] supplied to a shelter, as a rule, by the city electric-power grid through the apartment-house lead-in or through a separate lead-in [illegible] from a transformer substation. The main users of the shelter power [illegible] are the lighting network, the electric motors of the ventilation systems, pumps for artesian wells, and pumps for feeding potable and [illegible] water. The shelter's power grid should be switched on and off independently of other consumers of electricity. The power and lighting networks are made up separately, the lighting grid for the stairs, the entrances, the [illegible] area and other premises that are beyond the shelter's [illegible] being segregated into a separate group. Lighted indicators are installed near the entrances of the shelter and on the wall of the building.

Electric motors, distribution fixtures and cable systems and illuminating [illegible] of general industrial manufacture are used.

When selecting electrical equipment it must be considered that the shelter premises are damp, and, with regard to the degree of vulnerability to current, [illegible] in the premises with increased risk. The metal bodies of the electrical equipment and the bodies of the electric motors are grounded. The resistance of the protective ground should not exceed [illegible]. In case of damage and the city (or facility) power grid becomes inoperative, there must be manual means for illumination (storage battery, [illegible], and so on) in the shelter.

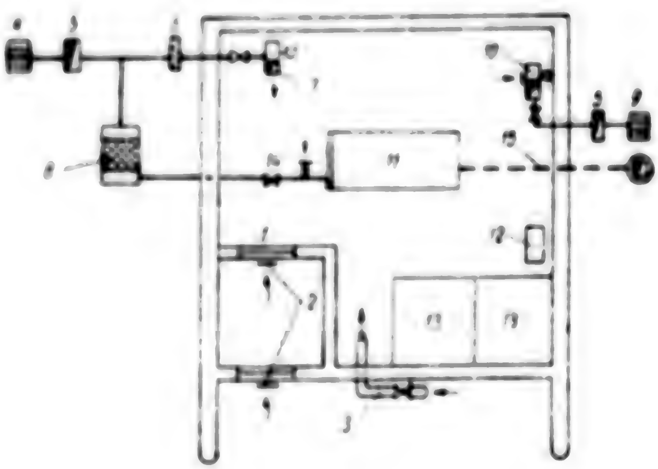
[illegible] use of [illegible] diesel-electric sets as emergency sources of electricity is [illegible] in large-capacity shelters. Diesel-electric sets are considered to be more desirable in providing electricity for groups of [illegible] shelters.

[illegible] sets are installed in a special premise within the shelter or in an equally strong freestanding structure. Collective antichemical and bacteriological protection in diesel-electric power plant (DES) premises should be specified. Servicing personnel should use individual means of protection during chemical (or bacteriological attack). Entry to the [illegible] premise should be made through a ventilating lock with double [illegible] doors.

[illegible] to use diesel-electric units with water-and-air radiator [illegible] systems that are produced serially by industry for electric-power [illegible] shelters. The capacity of the electric generators for autonomous [illegible] electric-power plants should be determined as a function [illegible] equipment, taking into account the factor of nonsimultaneity [illegible] for electric power, a shelter with a capacity of 1,000 people requires a generating set with a capacity of about 20 kw, while a shelter with a capacity of 100-300 people requires one of 3-5 kw.

[illegible] of the power-plant premise and cooling of the diesel-electric [illegible] with a radiator cooling system are accomplished by removing air from the main premises of the shelter, or by feeding outside air to the DES after the dust has been removed. The overflowing of air from the main [illegible] premises to the DES premise should be done through excess-pressure [illegible] that are installed in the sealing doors of the antechamber or along [illegible] with a sealing valve (figure 84). The air spent in the DES is [illegible] outside by means of an exhaust fan system. In this case the excess of exhaust over influx for the creation of a rarefaction within the [illegible] mm H_2O range should be specified for the DES premise.

Figure 84. Scheme for Ventilating the Premises of a DES (Diesel-Electric Plant).



Key:

1. Sealing door.
2. Excess pressure valve.
3. Pipeline with sealing valve.
4. Air intake cap.
5. Antiexplosion device.
6. Dust filter.
7. Intake fan.
8. Heat-absorbing filter.
9. Exhaust conduit.
10. Exhaust fan.
11. Diesel-electric set.
12. [illegible] air cooler.
13. [illegible] reserve water.
14. Sealing valve.
15. Exhaust pipeline.

The productivity of the DES's ventilation system, based upon the drive against excess heat, can be determined by the formula

$$L = \frac{Q_p}{c\gamma(t_{BH} - t_H)}, \tag{112}$$

where L is the amount of air required to be fed into the DES premise, in m^3/hr;

Q_p is the total heat input into the DES premise from the diesel unit, the generator and the electric motors for the fans and pumps, in kcal/hr;

c is the heat absorption of the air, in kcal/kg·degrees;

γ is the density of the air, in kg/m^3;

t_H is the temperature of the outside air estimated for design of the ventilation, or the temperature of the air removed from the shelter's main premises, which is assumed to be 25-27 degrees C; and

t_{BH} is the permissible temperature of the air in the DES premise.

Air consumption for ventilation of the power-plant premise and for cooling the electric unit in the central belt of the USSR averages about 100 m^3/hr per 1 hp of engine power. When the outside-air temperature is high, during fires, it is impossible to cool the diesel engine and the power-plant premise by outside air, so it is necessary in fire-hazard zones to specify cooling of the engine with water during the fires (10-12 hours) (see figure [illegible]). Reserves of water can be stored in the power plant premise or in the shelter. The consumption of water necessary for cooling the diesel unit should be taken from the estimate of 20-30 liters per 1 hp per hour, or determined by the formula

$$W = \frac{kNbB}{85 - t_0} \text{ liters/hr}, \tag{113}$$

where k = [illegible]-0.3 is the coefficient that covers the share of heat carried away by the cooling system;

b is the specific fuel consumption, in kg/hp·hr;

B is the heating capacity of the fuel in kcal/kg;

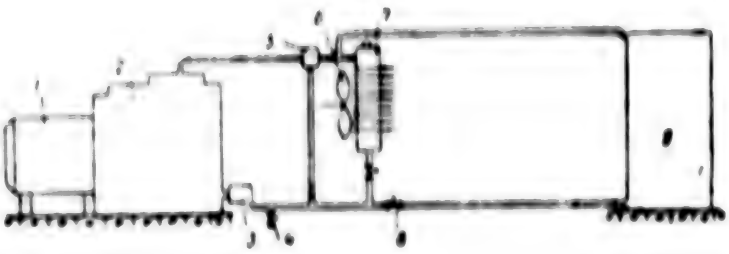
N is the engine power, in hp; and

t_0 is the initial temperature of the water in the emergency reservoir, in degrees C.

The removal of excess heat from the DES premise during the fire period should be done through absorption of the heat by the enclosing structure. During the fire period, a rise in air temperature in the DES premises to 45-50 degrees C is permitted.

If the enclosing structure does not provide for absorption of all the excess heat, then it is necessary to call for the installation of local air coolers.

Figure 85. Schematic Diagram of Cooling of the Engine of the Electric Power Unit in a Shelter.



Key:
1. Generator.
2. Motor of the electric power unit.
3. Water pump.
4. Drain cock.
5. Thermostat.
6. Axial fan.
7. Radiator.
8. Shut-off valve.
9. Reservoir with service-water reserve.

During fires, outside air for combustion can be fed directly into the diesel with preliminary cooling in a heat-absorbing filter. The volume of the heat-absorbing filter is determined on the basis of 1.7-1.8 m^3 of gravel with a layer thickness of 1 meter for each 300 m^3 of cooled air.

The intake and exhaust conduits of ventilation systems for the diesel-electric power plant are equipped with antiexplosion devices.

In order to avoid the entry of exhaust gases into the shelter with influx air, the head of the exhaust pipe must be placed at a distance of not less than 10 meters from the air-inlet cap. It is permissible not to install antiexplosion devices on the exhaust pipe.

The generator set operation should be provided with a reserve of fuel and lubricating materials for the whole period of uninterrupted engine operation.

6. Water Supply and Sewerage Systems

Water supply and sewerage for shelters are solved, as a rule, on the basis of the existing outside water and sewer mains of the city or of the facility. However, the probability of destruction of the outside network from the effect of nuclear weapons necessitates creation in the shelter of emergency water supplies and the installation of receptacles for foul sewage that operate independently of the condition of the external sewerage network.

In shelters that do not have special sanitary-engineering and electric-power equipment (air cooling and a diesel generator), water from the water-supply network is fed through an independent entrance to the lavatory and the flush tanks of the toilet bowls.

The minimum water consumption for drinking needs and for washing hands in the shelter is 3.5-4 liters per person per day; for normal sewerage functioning, the requirement for water reaches 20 liters, taking the flushing [illegible] into account.

Thus, in a shelter with a capacity of 300 persons, daily water consumption is about 7 m^3, of which 1 m^3 will be spent on drinking needs and 6 m^3 on servicing the sewerage.

Supplying shelters with water in such amounts does not cause any difficulty when the outside network operates properly. The installation of emergency tanks greatly complicates the internal water supply of a shelter, so it is desirable to call for an emergency water reserve just to meet the drinking requirements and to construct nonflushing containers for the reception of feces.

Pressurized running-water reservoirs or nonpressurized tanks equipped with replaceable [illegible] and water-level indicators can be used to store an emergency water reserve.

The inner surfaces of the metal tanks are coated with iron oxide or are covered with an anticorrosion composition that does not affect the water's drinking qualities. The tanks should be painted on the outside with a double coat of oil paint.

For the most economical expenditure of the emergency water reserve, tanks should be equipped with valves by means of which the drinking water tanks that are installed in each shelter compartment can be filled on the basis of one tank for 75 persons.

Boilers, galvanized or tinned containers, reinforced-concrete reservoirs and other containers can also be used as tanks.

The containers can be placed in the shelter or in direct proximity to it, provided they are given equal protection. It is desirable that running-water tanks be placed under the ceiling in the rest rooms, with nonpressurized tanks placed in special premises. When the tanks are placed outside the shelter, a manual pump can be used to supply water to the user. A schematic diagram for the water supply of a shelter is shown in Figure [illegible].

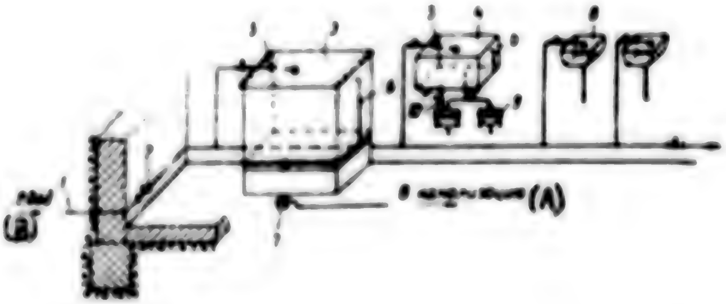


Figure [illegible]. Diagram of a shelter water supply.

Key:
1. Intake from outside water line.
2. Outer wall.
3. Tank with reserve water for drinking.
4. Pressurized tank with water for washing.
5. Float valves.
6. Water level indicator.
7. Trap
8. Flush tanks.
9. Basin.
10. Drain pipe.

A. To the sewer system.
B. Inlet.

The pipelines inside the shelter should be made of galvanized pipe. A shutoff and a pressure gage are installed on the pipelines.

Where hydrogeological conditions are favorable, ground water from upper horizons may be used as an emergency water supply by digging or drilling wells. As a rule, underground water does not need to be settled or safeguarded, and it is practically protected by the ground cover from contamination by radioactive or toxic substances or by bacterial agents [50, 51].

It is most desirable to arrange for dug or artesian wells in large-capacity shelters that have an emergency source of electricity and are equipped with water-cooling installations.

In this case the well flow and pump capacity should be selected to take into account the supplying of water for the enumerated installations, the rest rooms and the occupants' drinking-water requirements.

If basements are adapted as shelters "in a hurry" and are equipped with the simplest of resources, water supply can be solved by creating [illegible] drinking-water reserves that are stored within the shelter.

The clearance dimensions of reserve tanks and drinking-water containers should allow their passage through door openings of 60x160 cm. In order to make the water safe after the tanks are filled, there should be a reserve of chloride of lime or of DTS-GK [a mixture of 3 parts calcium hypochlorite and 2 parts calcium hydroxide] powder in the shelter. To chlorinate 1 m^3 of water, 8-10 grams of chloride of lime or 4-5 grams of DTS-GK powder are required.

For removing waste and foul sewage, shelters that are situated in areas with sewerage systems are equipped with flush-type sewerage. Depending upon the location of the shelters, drain water can be released into the existing sewer network by gravity flow or by pumping. The floor level of toilets may be raised 50 cm in order to utilize the advantages of gravity-flow sewers.

An inside sewer network should have an independent release with a shutoff.

Separate men's and women's toilet facilities are built in the rest rooms. The total number of sanitary facilities is established on the basis of 1 toilet bowl for 75 persons and 1 wash basin for 150 persons.

Emergency sewerage arrangements--tanks for collecting impurities (air-gap closets)--are called for in case the inside water-supply and sewerage systems are damaged.

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[50] [illegible], V. V. and Sokolova, N. [illegible] "Kak ochistit' i obezzarazit' vodu s pomoshch'yu prosteyshikh sredstv" [How to Purify and Decontaminate Water by the Simplest Means]. Meditsina, 1965.
[51] [illegible]harmanovskiy, S. "Vodosnabzheniye i kanalizatsiya poselkov" [Water Supply and Sewerage Systems of Settlements]. Moskovskiy Rabochiy, [illegible].

The installing only of nonflush toilets--air-gap closets and receiver-tank cesspools (periodically drained cesspools)--is permitted for shelters that are erected hurriedly or are located in regions without sewer systems, since erection of a local flush-type sewerage system requires substantial material expenditure and time.

When air-gap closets are installed, special attention must be paid to creating sanitary conditions, for which purpose exhaust ventilation is used, and [illegible] and receivers of impurities are rendered harmless with chloride of lime or other disinfecting agents.

Figure 87 shows a scheme for a gravity-flow flushing sewerage system that is specified for use under normal and emergency regimes.

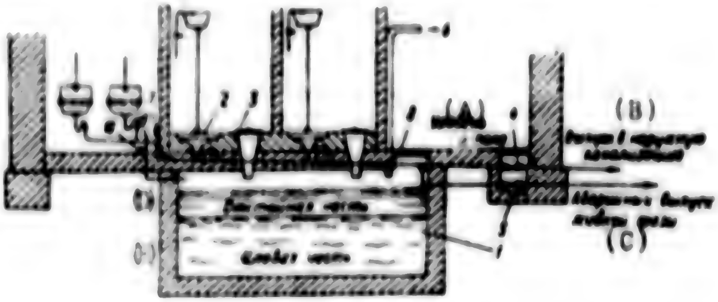


Figure 87. Diagram of gravity-flow sewerage.

KEY:
1. Collecting reservoir.
2. Flush toilet bowl (ground type).
3. Nonflush toilet bowl.
4. Sewerage conduit on the discharge [illegible].
5. Sewerage [illegible] on the emergency drain.
6. Exhaust ventilation pipe.
7. [illegible]
8. Trap door.
9. Valve on discharge pipe.
10. Valve on emergency drain.

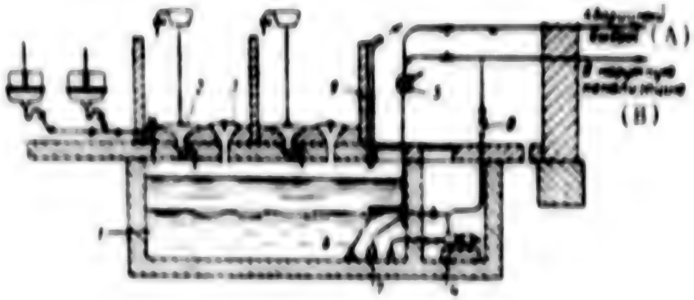
A. Floor level.
B. Release into outside sewerage system.
C. Emergency release of liquid phase.
D. Settling part.
E. Slimy part.

Standard flush toilets or ground-type Genuya toilets are used under the normal operating regime. Foul sewage enters the discharge pipe and is removed by gravity flow into the external sewerage system. The sewerage system is converted to an emergency mode when the external network is damaged or there is no water or not enough of it for flushing. In this case, nonflush toilets are used and all the foul sewage and drain water are collected in the cesspool, where they are settled. From the cesspool, the liquid part of the impurities is released by gravity flow or by means of a manual pump through the emergency release to the surface or to an underground filtration drainage pipe.

The volume of the receiving tank or cesspool is adopted on the basis of [illegible] liters per person per day.

If gravity-flow removal of drain water into the outside network is impossible, a pressurized sewerage system that moves impurities by means of a sewer pump is built in accordance with the scheme shown in figure 88. In this case, if the shelter's rest room is to be operated also in peacetime, the pump station should be built outside the structure (or building).

Figure 88. Diagram of Pressurized Sewerage System with Pumping



Key:
1. Receiving reservoir.
2. Flush toilet bowl.
3. Emergency nonflush toilet bowl.
4. Electric foul-sewage pump.
5. Emergency hand pump.
6. Grating
7. Hydraulic stirrer for roiling.
8. Check valve.
9. Exhaust ventilation pipe.

A. Emergency discharge.
B. To the outside sewerage system.

7. Internal Equipment for Shelters, Made from Materials at Hand

The equipping of shelters with air-supply devices can be impeded by lack of enough ventilation-filtration installations made industrially or by the delayed delivery of them to the place of shelter construction during large-scale construction. In this case, wide use can be made of the simplest means for air supply, which are made from materials at hand and will reliably provide collective protection from all types of mass-destruction weapons.

The simplest means for air supply that are examined below were intended for mass fabrication by the efforts of the populace. It is desirable, when these facilities are being fabricated, to organize the centralized supply of the basic materials for absorber filters and forced air-feed equipment.

Sand, crushed slag and coquina can be used as absorbent filters. These materials should be procured ahead of time.

Bellows-bags made out of wood, oilcloth, leatherette, rubberized cloth and so on can be used for air feed.

ERV-49 type centrifugal fans with manual drive or simple fans made from materials at hand can be used in shelters. The fan pressure head should be 60-70 mm H_2O, and air productivity should be 300-350 m^3/hr.

Preparing the facilities for feeding air or the materials for them ahead of time can substantially increase the potential for providing for the collective protection of the populace, especially in the equipping of existing structures as shelters and covers (the basements of buildings, pedestrian crossings, underground receptacles, buried industrial premises of enterprises, and so on).

The simplest ventilation-filtration installation made of materials at hand for shelters and covers consists of a filter, wooden ducts and bellows-bags (Figure 89).

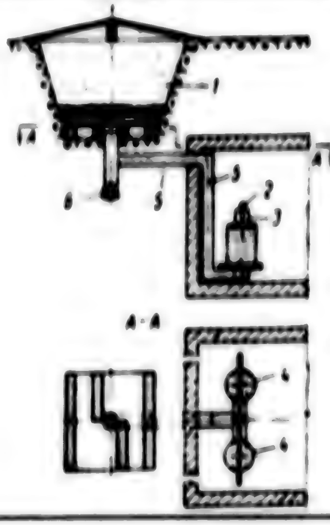


Figure 89. Ventilation-Filtration Installation Made of Materials at Hand.

Key:

1. Sand filter.	4. Bellows bag.
2. Lever.	5. Duct.
3. Upright.	6. Drain

The filter is built in a pit, the slopes of which are covered by a layer of roll waterproofing or a layer of crumbled clay 10 cm thick. It can also be erected in a free premise of a basement near the shelter. The filter's walls should be built of brick or wood and carefully sealed. The walls' inside surfaces should have ribs that project into the fill material, to avoid infiltration of air between the walls and the fill.

The pit at the filter's bottom is made 140-190 cm for a ventilation-filtration installation with a productivity of 150 m^3/hr, or 140x410 cm for an installation with a productivity of 300 m^3/hr, and the pit is 140 cm deep. A grating of logs 12-15 cm in diameter is laid at the bottom of the pit. A 10-cm thick layer of gravel with a particle size of 20-40 mm is placed on the grating, and then a layer of 5-6 cm with a particle size of 5-10 mm is laid down. The fill, taken from local filtering materials, is placed on the gravel.

Protection of the filters from atmospheric precipitation is provided by a board panel covered with a layer of bituminous roofing material.

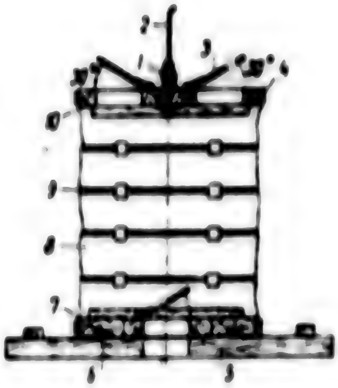
It is best to make the wooden ducts out of dry planks 40-50 mm thick. When damp wood is used for this purpose, planks 25 mm thick are used and the ductwork is made in two layers, with artificial parchment paper, bituminous roofing material or bituminized paper, which provides a seal, laid between them. The ductwork is joined by overlapping with packing strips made of the sealing materials named. The portion of the ducts that lies within the shelter should be sealed especially carefully.

For feeding outside air into the shelter through the filter, an installation with a productivity of 150 or 300 m^3/hr, which consists of one or two bellows-bags (the paired version) is used.

The bellows bag consists of a cover, a bottom and an envelope (the bag) (Figure 90). On the cover are two metal valves intended for release of the air and on the bottom is a check valve for the intake of air.

Figure 80. General View of the Bellows Bag.

Key:
1. Holder, with M12 nut and washers.
2. Cable or rope, 700 mm long.
3. Valve.
4. Rim.
5. Mounting plank.
6. Rubber or cardboard packing of 230x500 mm, with 130x130 opening.
7. Bottom.
8. Bag.
9. Ring.
10. Cover.



The top and bottom of a bellows-bag with a productivity of 150 m^3/hr is 65 cm in diameter; height of the bag is 60 cm.

The top and bottom are made circular in shape out of dry or damp planking or any sort of wood 40-50 mm thick. When making these parts out of dried planks, the places of joining are daubed with carpenters' or casein glue prior to being nailed together. If damp planks are used, the top and bottom are covered with plywood, roofing iron, rubberized fabric, oilcloth, or leatherette, for sealing purposes. A top and bottom made of damp wood 25 mm thick can be fabricated from two layers of material, with sealing materials laid between them.

The envelope of the bellows bag is made from rubberized cloth, leatherette, oilcloth, synthetic film, and so on. In order to provide the required mechanical strength for the envelope, it is desirable to make it two-layer, the inner layer being made of burlap, tarpaulin or other strong fabric.

When the bellows pumps air, the envelope is supported by the metal rings, which are made of wire 6 mm in diameter. The top and bottom are joined with the bag by a hoop made of strap iron, using nails.

The bottom of the bellows bag is attached to the duct by a special mounting plank, with rubber or paper packing. First the mounting plank is nailed to the bottom, and then its protruding ends are nailed to the duct.

Installations made of bellows bags are brought into operation by a wooden lever 50-55 mm in diameter. For an installation of one bellows bag, the lever is made 2 meters long, the one on the paired version is 2.6 meters long.

The lever is joined with the top by a soft wire, a cable, binder twine or cord.

The amount of materials required to make one ventilation-filtration installation with a productivity of 300 m^3/hr is shown in table 36.

Table 36

Materials for Fabricating a Ventilation-Filtration Installation with a Productivity of 300 m^3/hr

Materials	Unit of measurement	Amount
Sand with grain size of 0.15-2 mm..................	m^3	12
Gravel with grain size of 5-40 mm..................	m^3	0.85
Logs, 100-150 mm in diameter.....................	m^3	0.9
Planks, 40-50 mm thick............................	m^3	0.4
Boards (in the absence of planks)................	m^3	0.5
Bituminous roofing material or roofing paper......	m^2	25
Material for sealing the bellows-bag envelope (oilcloth, rubberized fabric, leatherette, and so on)......................................	m^2	5
Material for the inner envelope (burlap or strong cloth)..	m^2	5
Sheet steel, 1 mm thick..........................	kg	1.5
Wire, steel, 6 mm in diameter....................	running meters	30
Band iron, 0.5 mm thick..........................	kg	1.5
Nails, 4x100 mm...................................	kg	1.2
Glue, casein or carpenters'......................	kg	0.5

In order to place a bellows bag with an air productivity of 150 m^3/hr in a shelter, an area of 0.7x3 meters is required, while for a paired installation of two such bellows-bags, 0.7x3.5 meters is required.

The dimensions and productivity of bellows bags can be different, and this is determined by calculation as a function of the capacity of the shelter or other.

The full head of the bellows bag can be determined by the formula

$$H_{п} = \Sigma\zeta\frac{v^2}{2g}\gamma + H_{ф} + H_{д}$$

or

$$H_{п} = (\Sigma\zeta + 1)\frac{v^2}{2g}\gamma + H_{ф} \text{ kg-force/m}^2, \qquad (114)$$

where $\Sigma\zeta$ are the coefficients of local resistance of the air intake;
v is the speed of the air in the duct, in m/sec;
γ is the density of the air, in kg/m^3;
$H_{ф}$ is the aerodynamic resistance of the absorbent filter; assumed to be equal to 50-60 mm H_2O; and
$H_{д} = \frac{v^2}{2g}\gamma$ is the dynamic head in the duct of the installation, in kg-force/m^2.

The productivity of the bellows-bag can be found from the formula:

$$L_1 = 60F(h - a)n\eta \ m^3/hr, \tag{115}$$

and for the paired installation of two bellows bags, it is

$$L_2 = 120F(h - a)n\eta \ m^3/hr, \tag{116}$$

where F is the area of the top of the bellows bag, in m^2;
h is the height of the bag, in meters;
a is the unused height of the bag, in meters;
n is the number of pumping motions per minute; and
η is the efficiency factor of the installation, which considers the amount of air pumped into the bellows-bag from the shelter through various leaks.

The efficiency factor value can be assumed to be 80-90 percent.

The effort during manual drive of the installation with one bellows-bag is determined by the equation

$$(FH + G_{kp})\ell_1 = P\ell_2$$

and

$$P = (FH\eta + G_{kp})\frac{\ell_1}{\ell_2} \text{ kg-force}, \tag{117}$$

where G_{kp} is the weight of the top, in kg;
ℓ_1 is the length of the lever, from the center of the cover to the support, in meters;
$\ell_2 = \ell - \ell_1$ is the length of the remaining portion of the lever, in meters; and
P is the effort during manual drive of the installation, in kg-force.

For an installation made up of two bellows bags, the force on the lever is determined from the formula

$$P = FH\eta\frac{\ell_1}{\ell_2} \text{ kg-force}, \tag{118}$$

where ℓ is the length of the whole lever, in meters; and
ℓ_1 is the distance between centers of the covers of the bellows-bags, in meters.

The most widely used material that can be used as fill for the filters is sand.

The height of the layer of the sand pit that provides for removal of the toxic substances and bacterial agents from the air should be 1 meter.

For the reliable removal of toxic substances, bacterial agents and radioactive dust from the air, a layer of sand 1 meter thick should have an aerodynamic resistance of at least 50 mm H_2O at a pumping speed of 0.05 liter/cm^2•min of air.

The aerodynamic resistance of the sand filters depends upon several factors. The main ones are: thickness of the layer, humidity and grain size of the sand, and conditions for filling the filter.

It is known that the aerodynamic resistance in filters grows in direct proportion to increase in the thickness of the fill layer. This is observed also in sand filters. Thus, for example, the resistance of a fill layer of sand, 50 cm thick, with a grain size of 0.15-2 mm, is 30 mm H_2O, and for a layer 100 cm thick the resistance is 58-60 mm H_2O. With increase in moisture content, the sand's resistance is reduced. For example, sand with a grain size of 0.15-2 mm in a filter with a layer thickness of 1 meter and a moisture content of 0.86 percent (by weight) has an aerodynamic resistance of 80 mm H_2O, but where the moisture content is 3.46 percent, its resistance is 40 mm H_2O.

Sand with a large content of fine fractions has greater resistance. For example, sand with a grain size of 0.15-3 mm has, where the layer is 1 meter thick, an aerodynamic resistance of 60 mm H_2O, but with a grain size of 0.3-5 mm the figure is 46 mm H_2O (with identical moisture content).

Density also exercises a considerable influence on the aerodynamic resistance of sand in a filter.

The aerodynamic resistance of unsifted sand with the natural moisture content (less than 4 percent) of the fractional makeup that is suitable for making concrete (GOST 8736-58), can be increased after manual tamping [illegible]-fold to 2.5-fold. However, the maximum aerodynamic resistance in this case is [illegible] mm H_2O. A filter with such aerodynamic resistance can be used for purifying the air when the layer is 1 meter thick.

Even dry sand with a grain size of 0.3-3 mm can be used for filter fill. The aerodynamic resistance of a 1-meter layer of such sand does not exceed 60 mm H_2O. However, in order to obtain dry sand suitable for filters, it is necessary to dry and sift fine sand fractions, and substantial expenditure of efforts and funds is required for this. Unsifted dry sand has very great dynamic resistance and is unsuitable as a fill for absorbend filters.

With the operation of sand filters made of unsifted sand with a natural moisture content (of less than 4 percent) and with fractional composition in accordance with GOST 8736-58, neither freezing nor dessication, nor substantial changes of aerodynamic resistance occurs during summer or

winter. Such sand can be used widely as fill in absorbent filters. In order to provide for reliable air purification, sand with natural moisture content should, after filling, be tamped manually.

Boiler slag, when precrushed and sifted, can also be used as fill for the filters. The air-purification effectiveness of a slag filter is higher than that of sand because of the better-developed surface of the slag particles.

In filters, it is desirable to use slag with a particle size of 0.15-3 mm. Such slag is easy to prepare manually by crushing lumps of it on a concrete slab with wooden tampers. The crushed slag should be sifted through a sieve with cells of 5 mm that is set at an angle of 45 degrees to the ground surface, with winnowing of the dust. In this case the slag siftings comprise 50 percent.

A slag filter with a particle size of 0.15-3 mm provides reliable air purification when the layer thickness is 70-75 cm.

Crushed and sifted coquina with a particle size of 0.5-1 mm and a layer thickness of 65-70 cm can be used for filter fill.

After assembly of a ventilation-filtration installation that is made of materials at hand, it is necessary to carefully check the seal thereof in order to enable feed of the required amount of air to the shelter. Places not sealed are observed by the bending of a candle flame.

In checking, main attention should be paid to the following:

Tightness of abutment of valves to the cover and the bottom of the bellows-bag;

Seal of the envelope;

Tightness of joining of the bags with the edges of the top and bottom;

Seal of the joining of the bottom with the duct and with the mounting plank; and

Seal of the portion of the ducts that is situated in the shelter.

The places where lack of tightness is observed are glued or spread with modeling clay, putty, pitch or other materials.

During operation it is necessary to check periodically the seal of the ventilation-filtration installation and to eliminate observed defects.

To remove radioactive dust from outside air under the pure ventilation mode, filters made of sand, coal slag and coquina can be built with a fill layer 20-25 cm thick.

In addition to the indicated filters for removing radioactive dust from the air, corduroy, woolen cloth or flannel sewn in the form of a bag can be used.

Cloth filters are installed at the reserve outlet (emergency manhole) that is used as an air intake conduit. In this case the cloth filter is installed so that the air enters the shaggy side of the cloth first. The area of a cloth filter is chosen on the basis of purifying 75-115 m^3/hr of air per square meter of filter.

In a manhole-passage the filter is fastened to the enclosing structure, and the end of the filter is attached to the wooden frame, which is tightly contiguous to the enclosure structure. If it is necessary to construct an exit from the shelter through the manhole, the cloth filter is taken off, rolled up or cut off.

A simplified protective section with wooden frame is used as an antiexplosion device ahead of the filter. The air can be fed under a pure ventilation mode by means of a bellows-bag or by fans that have manual drive, through a reduction gear.

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CIVIL DEFENSE: WEST GERMAN REPORT ON SOVIET YOUTH TRAINING

Bonn DIE WELT in German 1[illegible] Aug 80 p 5

[Report by Barton Reppert]

> [Text] According to the opinion of the British government, the USSR has available "substantial offensive capacity" in form of poison gases. The Soviets are said to have around 20,000 tons of a chemical substance for military purposes known in the West as VR-55. It is based on the nerve gas "sarin" produced for the German armed forces.

Gas masks and respiration equipment, protective clothing against chemical warfare and nerve gas, as well as atomic fallout shelters: these items can be found not only in the arsenals of the Warsaw Pact forces, but are also part of the equipment of the 53,000 Soviet Young Pioneer camps where this summer Russian children between 7 and 15 are spending their summer vacations.

Soviet pioneer camps are different from vacation camps in the Western sense, where boy scouts and YMCA members engage in sports, stage hares-and-hounds hunts, hike or sing romantic songs around blazing camp fires. In the USSR, the children and young people living in pioneer camps are acquainted with the grim realities of atomic war, and with chemical and bacteriological warfare. They practice civil defense.

In the pioneer camps, theoretical instruction in the classroom is supplemented by practical exercises in civil defense. Some of these involve the correct use of the ABC protective mask, the digging of protective trenches, quick action after an attack warning, and the decontamination procedures after radioactive fallout or the use of bacteriological or chemical weapons.

Valentina Yermilova, spokeswoman of the Moscow Central Pioneer Organization, reports that 13 million Soviet youths are spending their summer vacations in pioneer camps. There is, however, no information on the exact number of young people participating in civil defense instruction.

The training of pioneers is part of the Soviet civil defense efforts in which, according to Western estimates, more than 100,000 persons are employed on a full-time basis. A report published by the CIA in 1978 states that the Soviets have built 15,000 atomic bomb shelters. By 1985, these shelters are to provide protection for between 15 and 30 percent of the population. The remainder of the population is to be evacuated to rural areas in case of war.

According to CIA estimates, the Soviet program costs more than 3 billion marks annually. In comparison, the United States spends only about 320 million marks annually for civil defense. There are no shelters available for major portions of the U.S. population. According to reports from Washington, 550 persons are employed full-time in civil defense on the federal level and 3,600 on the state and community levels. A total of 2,200 volunteers work part-time in civil defense.

Dosaaf, a volunteer organization active all over the Soviet Union in support of the army, air force and navy, has published a 78-page handbook entitled "Measures On Civil Defense in Pioneer Camps." Dosaaf supervises the para-military training of millions of school children in the entire USSR, and also assists in the military registration of men.

The handbook also contains questions and answers for quiz contests which test the knowledge of the Young Pioneers in the field of civil defense. Here are a few sample questions:

Question: "Is it possible to protect yourself from the pressure wave of an atomic explosion after you have observed this explosion from a considerable distance?"

Answer: "Yes. The bright flash of the explosion is visible over considerable distances, and the light of the explosion spreads immediately. The pressure wave has a velocity of 2 seconds per km for the initial kilometers, but afterwards its speed decreases. This means that it is possible to seek shelter a few seconds after the flash of the explosion has been observed."

Question: "Name four chief catagories of poison gases."

Answer: "Nerve gas, gases affecting the skin, general toxic gases and suffocation gases."

The handbook suggests to reward with "cake, torte or a trip" the particular pioneer group which does best in this test.

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